



Effect of growth regulators and stages of spray on seed yield and seed quality parameters of ridge gourd [*Luffa acutangula* (Roxb) L.]

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Abstract: The experiment was undertaken to study the influence of different growth regulators on seed yield and seed quality parameters in ridge gourd [*Luffa acutangula* (Roxb) L.]. There were 30 treatment combinations comprising of two factors; plant growth stage as main plot treatment, and plant growth regulators as sub plot treatment embedded in a split plot design. The results indicated that significantly the highest average fruit weight (32.76 g), matured fruit yield per plant (65.84 g), 100 seed weight (13.41 g) and seed yield per plant (12.79 g) was recorded with spraying of 500 ppm ethereal, whereas significantly the maximum fruit length (20.89 cm) and fruit diameter (5.15 cm) with 25 ppm GA₃. Significantly the highest seed germination (69.22 %) was recorded with spraying of 250 ppm ethereal, while application of NAA at 50 ppm recorded significantly the highest vigour index I (2737.85) and vigour index II (5029.33). Spraying of PGR at two to four leaf stage recorded the higher fruit length (20.19 cm), fruit yield per plant (47.49 g), 100 seed weight (13.18 g) and seed yield per plant (11.98 g) as well as highest germination (60.90%), vigour index I (2460.80) and vigour index II (4377.66). It is concluded that spraying of 500 ppm etherel at two to four leaf stage increased the higher fruit length, fruit yield per plant, 100 seed weight and seed yield per plant as well as highest germination, vigour index I and vigour index II.

Keywords: Growth stages, Growth regulators, Ridge gourd

INTRODUCTION

The effect of growth regulator varies with plant species, variety, their growth stage, concentration of chemicals, application method and frequency of application. Growth retardant like ethrel is the substance that slows down the cell division and cell elongation in meristamatic tissue of shoot and regulates the plant height without change in the morphology and physiology of the plant (Hilli *et al.*, 2010).

Seed is the basic and cheapest input among other inputs *viz.*, manures, fertilizer, pesticides fungicides etc. Use of high quality seed imparts higher yield and better quality produce. The production of genetically pure seed material and to preserve its quality from harvest to next planting season is very much essential. In a seed crop, use of growth regulators and stages of spray plays a very important role for development of plant and seed. They are known to modify the sex expression, the source-sink relationship and increase the translocation of synthates effectively resulting in increased seed yield and quality (Hilli *et al.* 2008).

Ridge gourd belonging to a family *Cucurbitacea*, is gaining commercial importance as green vegetable crop. There is a great potential to increase the seed yield with good quality parameters either by reducing flower drop or by increasing fruit set. To achieve this, plant growth regulators are considered as a new gen-

eration agro chemicals after fertilizers, pesticides and herbicides. Plant growth regulators have potential ability to increase the productivity of seed crop. The growth regulators such as gibbrellic acid stimulates the cell elongation of main shoot and roots, while ethrel induce maximum number of fruits, fruit length and ultimately seed yield in ridge gourd. It is quite apparent that no seed production techniques like spraying of proper growth regulators and standardized stages of spray on growth, fruit set and seed yield especially in ridge gourd is not available (Hilli *et al.* 2008). Hence, the present investigation was planned to develop a suitable seed production technology with growth regulator and stages of spray on seed yield and seed quality parameters of ridge gourd.

MATERIALS AND METHODS

A field experiment was conducted during summer 2013 at the Instructional Farm, Junagadh Agricultural University, Junagadh, Gujarat, India, whereas seed quality parameters from the seed produced in the field experiment were measured in the laboratory of Department of Seed Science and Technology, College of Agriculture JAU, Junagadh. There were 30 treatment combinations comprising of two factors; plant growth stage (M₁ = Two to four leaf stage, M₂ = Flower initiation stage and M₃ = Fifteen days after flower initiation

stage) as main plot treatment, and plant growth regulators (S₁ = 25 ppm GA₃, S₂ = 50 ppm GA₃, S₃ = 250 ppm Ethrel, S₄ = 500 ppm Ethrel, S₅ = 50 ppm NAA; S₆ = 100 ppm NAA, S₇ = 100ppm Cycocel, S₈ = 200 ppm Cycocel, S₉ = Water Spray and S₁₀ = Control (No Spray)) as sub plot treatment embedded in a split plot design with three replication. The observations on different quantitative characters viz., average fruit weight, fruit length, fruit diameter, mature fruit yield per plant, number of seed per fruit, 100 seed weight and seed yield per plant in the field were recorded in the field, whereas seed quality parameters, viz., germination percentage (ISTA, 1993) and vigour index I and vigour index II (Abdul Baki and Anderson, 1973) were measured in the laboratory. The analysis of the field observations (seed yield and its components) were performed following split plot design, whereas seed quality parameters were analyzed following factorial completely randomized design as suggested by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Effect of plant growth regulators and stages of spray on seed yield and seed quality parameters of ridge gourd is presented in Table 1. Significantly the maximum average fruit weight was recorded in 500 ppm ethrel S₄ treatment (32.76 g) and it was at par with 50 ppm NAA S₅ (29.80 g). Significantly the minimum average fruit weight was recorded in S₉ treatment (19.00 g). The result are agreed with Kumar and Rao (1988) who reported that fruit weight was significantly increased by ethereal. Hilli (2005) recorded the highest fruit weight with spraying of ethrel and NAA in ridge gourd. Significantly the maximum fruit length was recorded in S₁ treatment (20.89 cm) and it was at par with S₁₀ (20.27 cm), S₂ (20.60 cm), S₃ (19.62 cm), S₄ (19.56 cm), S₆ (19.29 cm) and S₅(18.80 cm). Significantly the minimum fruit length was recorded in S₇ (18.22 cm) treatment. Hilli (2005) reported increased in fruit length with GA₃ and etherel. Singh and Choudhury (1989) reported that application of GA₃ increased fruit length and Arora et al. (1987) reported maximum fruit length with etherel in ridge gourd. Dostogir et al. (2006) and Ghani et al. (2013) also reported similar finding that fruit length was increased with spraying of GA₃ in bitter gourd. The S₁ treatment (5.15 cm) manifested significantly the higher fruit diameters and it was at par with S₁₀ (4.42 cm) and S₃ (4.36 cm). The S₅ (3.93 cm) treatment gave significantly minimum fruit diameter. This finding are in conformity with the Singh and Choudhury (1989) and Hilli (2005), who reported that fruit diameter were increased with spraying of etherel in ridge gourd; and similarly Dostogir et al. (2006) and Ghani et al. (2013) also recoeded the same results in bitter gourd. Significantly the higher matured fruit yield per plant was recorded with etherel in S₄ treatment (65.84 g). Significantly the minimum mature fruit yield per plant was recorded in S₁₀ treat-

Table 1 . Effect of plant growth stages and plant growth regulators on seed yield and seed quality parameters of ridge gourd (*Luffa acutangula* L. Roxb).

Treatment	Average fruit weight (gm)				Fruit length (cm)				Fruit diameter (cm)			
	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean
S ₁ = 25 ppm GA ₃	18.67	27.93	19.73	22.11	23.80	21.80	17.07	20.89	4.12	6.68	4.66	5.15
S ₂ = 50 ppm GA ₃	28.60	17.33	22.53	22.82	23.73	18.93	19.13	20.60	3.83	3.90	4.46	4.06
S ₃ = 250 ppm Ethrel	22.47	24.73	21.00	22.73	20.20	19.60	19.07	19.62	4.54	4.56	3.97	4.36
S ₄ = 500 ppm Ethrel	54.40	20.80	23.07	32.76	21.00	19.20	18.47	19.56	3.87	4.00	3.99	3.95
S ₅ = 50 ppm NAA	14.60	57.07	17.73	29.80	16.53	22.53	17.33	18.80	3.70	4.03	4.07	3.93
S ₆ = 100 ppm NAA	24.60	36.13	19.87	26.87	18.07	20.27	19.53	19.29	3.97	4.14	3.87	3.99
S ₇ = 100ppm Cycocel	20.93	19.93	26.73	22.53	18.27	18.53	17.87	18.22	4.00	4.08	4.37	4.15
S ₈ = 200 ppm Cycocel	20.47	39.07	15.87	25.13	19.53	19.07	16.87	18.49	3.87	4.22	3.88	3.99
S ₉ = Water Spray	15.87	20.40	20.73	19.00	19.53	19.20	17.47	18.73	4.40	3.99	4.40	4.26
S ₁₀ = Control (No Spray)	19.00	21.73	17.20	19.31	21.27	20.87	18.67	20.27	4.65	4.55	4.07	4.42
Mean	23.96	28.51	20.45	24.31	20.19	20.00	18.15	19.45	4.09	4.41	4.17	4.23
	M	S	M × S	M	M	S	M × S	M	M	S	M × S	M × S
S.Em.	0.32	0.95		1.65	0.30	0.55		0.96	0.13	0.19		0.33
C.D.	1.25	3.71		6.45	1.17	2.15		3.75	NS	0.74		1.29
C. V. %	7.15	11.72		11.72	8.51	8.51		8.51	16.63	13.50		13.50

Contd.....

Table 1 . Contd.....

Treatment	Matured fruit yield / plant (gm)			No. of seed / fruit			100 seed weight (gm)			Seed yield / plant (gm)						
	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean
S ₁ = 25 ppm GA ₃	32.53	46.07	42.07	40.22	76.00	58.87	40.33	58.40	13.08	12.78	13.90	13.25	11.42	9.42	6.82	9.22
S ₂ = 50 ppm GA ₃	58.73	21.73	35.73	38.73	55.00	51.67	53.60	53.42	13.45	12.70	13.10	13.08	10.55	6.55	8.28	8.46
S ₃ = 250 ppm Ethrel	44.73	35.27	38.80	39.60	58.73	63.87	45.40	56.00	12.21	13.33	13.87	13.14	9.11	11.58	9.69	10.13
S ₄ = 500 ppm Ethrel	43.27	24.47	29.80	65.84	72.53	66.73	40.53	59.93	13.55	14.14	12.55	13.41	18.14	9.42	10.82	12.79
S ₅ = 50 ppm NAA	33.27	92.03	25.60	50.30	35.13	57.20	67.53	53.29	13.14	13.07	12.37	12.86	8.37	9.26	8.26	8.63
S ₆ = 100 ppm NAA	35.93	55.87	22.80	38.20	60.67	76.27	42.93	59.96	13.66	11.76	13.15	12.86	9.72	8.92	11.61	10.09
S ₇ = 100ppm Cycocel	32.07	24.60	41.73	32.80	54.13	67.40	56.73	59.42	13.63	12.80	12.17	12.87	11.47	9.69	7.84	9.67
S ₈ = 200 ppm Cycocel	41.60	39.07	26.20	35.62	54.27	65.60	46.20	55.36	12.87	12.23	12.60	12.56	15.05	7.25	5.79	9.36
S ₉ = Water Spray	31.40	33.87	45.07	36.78	53.47	52.20	54.53	53.40	12.17	13.57	12.00	12.58	14.54	6.46	9.97	10.33
S ₁₀ = Control (No Spray)	21.40	23.73	34.13	26.42	50.20	46.00	53.40	49.87	14.01	11.87	11.90	12.57	11.46	7.23	7.21	8.63
Mean	47.49	39.67	34.19	40.45	57.01	60.58	50.12	55.90	13.18	12.82	12.76	12.92	11.98	8.58	8.63	9.73
	M	S	M × S	M	M	S	M × S	M	M	S	M × S	M	M	S	M × S	M × S
S.Em.	0.91	1.17		2.03	0.54	1.49		2.58	0.34	0.49		0.85	0.31	0.50		0.87
C.D.	3.57	4.57		7.94	2.11	5.82		10.09	NS	NS		NS	1.22	1.95		3.40
C.V.%	12.32	8.70		8.70	5.32	7.99		7.99	14.23	11.36		11.36	17.50	15.48		15.48

Table 1 . Contd.....

Treatment	Germination Percentage			Vigour Index I			Vigour Index II					
	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean	M ₁	M ₂	M ₃	Mean
S ₁ = 25 ppm GA ₃	66.67	54.67	65.33	62.22	2650.77	2306.93	2567.33	2508.35	4117.47	4166.07	3605.27	3962.93
S ₂ = 50 ppm GA ₃	46.00	74.00	65.33	61.78	2024.40	2973.47	2865.13	2621.00	3506.67	4548.53	4225.20	4093.47
S ₃ = 250 ppm Ethrel	52.00	69.00	86.67	69.22	2004.07	2842.67	2958.47	2601.73	5412.53	4841.20	4684.27	4979.33
S ₄ = 500 ppm Ethrel	48.00	62.00	56.33	55.44	2085.93	2434.60	2040.43	2186.99	3183.20	4797.73	3446.73	3809.22
S ₅ = 50 ppm NAA	67.33	69.33	61.33	66.00	2600.35	2679.87	2933.33	2737.85	3326.00	5744.07	6017.93	5029.33
S ₆ = 100 ppm NAA	77.67	66.00	53.33	69.00	3218.00	2252.35	2378.40	2616.25	5480.47	3221.73	5759.07	4820.42
S ₇ = 100ppm Cycocel	77.33	56.67	64.33	66.11	3270.67	2388.33	2301.47	2653.49	6013.07	4746.80	4277.47	5012.44
S ₈ = 200 ppm Cycocel	47.33	49.33	46.00	47.56	1812.27	2028.67	1865.00	1901.98	3649.07	3246.40	3432.53	3442.67
S ₉ = Water Spray	70.00	50.00	42.00	54.00	2877.40	2078.07	1596.47	2183.98	5048.93	3320.20	3020.53	3796.56
S ₁₀ = Control (No Spray)	56.67	51.33	53.33	53.78	2064.13	1987.93	2290.67	2114.24	4039.20	3826.00	3790.13	3885.11
Mean	60.90	60.23	60.40	60.51	2460.80	2397.29	2379.67	2412.59	4377.66	4245.87	4225.91	4283.15
	M	S	M × S	M	M	S	M × S	M	M	S	M × S	M × S
S.Em.	0.41	0.75		1.31	21.08	38.49		66.65	37.90	69.19		119.84
C.D.	NS	2.14		3.71	59.77	109.13		189.03	107.48	196.23		339.88
C.V.%	4.48	3.75		3.75	3.82	4.79		4.79	5.22	4.85		4.85

ment (26.42 g). Similar results were also obtained by Arora *et al.* (1987), Kumar and Rao (1988), Singh and Choudhury (1989) and Hilli (2005), who reported that the mature fruit yield was increased with spraying of etherel in ridge gourd. Jadav *et al.* (2010) and Thappa *et al.* (2011) also recorded the same results in cucumber. Baset *et al.* (2014) reported that fruit yield was increased with etherel in bitter gourd. Significantly the highest number of seed per fruit was recorded in S₆ treatment (59.96) and it was at par with S₄ (59.93), S₇ (59.42), S₁ (58.40), S₃ (56.00) and S₈ (55.36). Significantly the lowest number of seed per fruit was recorded in S₁₀ treatment (49.87). The findings were in accordance with Hilli (2005), who reported significantly the highest number of seed per fruit with application of NAA in ridge gourd, similarly, Gedam *et al.* (1996); Gedam *et al.* (1998) and Marbhal *et al.* (2005), who also reported the same results in bitter gourd. Significantly the highest 100 seed weight was recorded in S₄ treatment (13.41 g) followed by S₁ (13.25 g). The minimum 100 seed weight was observed in S₈ treatment (12.56 g). This finding were conformed by Hilli (2005), who recorded the highest 100 seed weight with the application of etherel in ridge gourd, and same results was also reported by Gedam *et al.* (1996) in bitter gourd and Ram *et al.* (1988) in cucumber. The S₄ treatment (12.79 g) noted significantly the highest seed yield per plant than all treatments. The S₂ treatment (8.46 g) produced the minimum seed yield per plant. Results in accordance with the results of Hilli *et al.* (2010), who recorded the highest seed yield per plant with all the treatments in ridge gourd. Similar results were also reported by Marbhal *et al.* (2005) and Shantappa *et al.* (2007) in bitter gourd.

Significantly the highest seed germination was recorded in S₃ treatment (69.22%) and it was at par with S₆ (69.00%). The significantly minimum seed germination was observed in S₈ treatment (47.56%). The results are similar to the findings reported by Hilli (2005), Hilli *et al.* (2008) and Hilli *et al.* (2010), who recorded the highest germination with etherel in ridge gourd. Same finding are conformed by Gedam *et al.* (1996) and Shantappa *et al.* (2007) with application of etherel in bitter gourd. The application of NAA at 50 ppm (S₅ treatment) recorded significantly the highest vigour index I (2737.85) and vigour index II (5029.33) and it was at par with S₇ (2653.49 and 4979.33, respectively). The present findings are in conformity with Hilli (2005) and Hilli *et al.* (2008), who recorded highest vigour index I and vigour index II with application of NAA in ridge gourd and Shantappa *et al.* (2007) in bitter gourd. Significantly the lowest vigour index I and vigour index II was observed in S₈ treatment with a value of 1901.98 and 3442.67 in that order.

Spraying of plant growth regulators at flower initiation stage recorded the maximum fruit weight (28.51 g), fruit diameter (4.41 cm) and number of seed per fruit

(60.58). These results are in agreement with the results of Hilli (2005) and Hilli *et al.* (2008) who observed maximum fruit weight, fruit diameter and number of seed per fruit with application of plant growth regulators at flower initiation stage in ridge gourd. Similar results are conformed by Ghani *et al.* (2013) in bitter gourd, Spraying of plant growth regulators at two to four leaf stage recorded the higher fruit length (20.19 cm), fruit yield per plant (47.49 g), 100 seed weight (13.18 g) and seed yield per plant (11.98 g). The findings are similar as reported by Hilli *et al.* (2010) in ridge gourd; and Shantappa *et al.* (2007) and Ghani *et al.* (2013) in bitter gourd.

Spraying of growth regulators at two to four leaf stage recorded highest germination (60.90%), vigour index I (2460.80) and vigour index II (4377.66). The present findings are in conformity with Hilli (2005) and Hilli *et al.* (2008) who recorded the highest seed germination, vigour index I and vigour index II were application of plant growth regulators at two to four leaf stage in ridge gourd.

Conclusion

From the results, it can be concluded that spraying of 500 ppm ethrel is recommended to increase the average fruit weight (32.76 g), matured fruit yield per plant (65.84 g), 100 seed weight (13.41 g) and seed yield per plant (12.79 g) in ridge gourd. However, spraying of 25 ppm GA₃ increased the fruit length (20.89 cm) and fruit diameter (4.42 cm), whereas spraying of 250 ppm etherl is recommended for increasing germination percentage (69.22%) and 50 ppm NAA for vigour index I (2737.85) and vigour index II (5029.33). Spraying of plant growth regulator at two to four leaf stage is recommended to increase the higher fruit length (20.89 cm), fruit yield per plant (65.84 g), 100 seed weight (13.41 g) and seed yield per plant (11.98 g) as well as highest germination (69.22%), vigour index I (2737.85) and vigour index II (5029.33).

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