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Effect of Fruit Load and Growth Regulators on Seed Yield and Quality in Watermelon Hybrid Seed Production

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Abstract An experiment was conducted to study the effect of fruit load and growth regulators on seed yield and quality of hybrid watermelon (*Citrullus lanatus* Thunb) Arka Jyothi. The experiment was laid out in randomized block design (RBD) with two factorial concept (four fruit load levels as main factor viz. L_1 : Two fruits retained per vine, L_2 : Three fruits retained per vine, L_3 : Four fruits retained per vine, L_4 : All fruits retained per vine and five growth regulators as sub factor viz. G_1 : No spray (water spray), G_2 : GA_3 @ 25 ppm, G_3 : Ethrel @ 250 ppm, G_4 : TIBA @ 500 ppm, G_5 : CCC @ 500 ppm) in three replications. The results indicated that better seed quality could be obtained by spraying ethrel @ 250 ppm and retention of two fruits per vine in hybrid watermelon seed production. From these results, it can be stated that, consistently higher seed yield could be obtained by spraying ethrel @ 250 ppm at three fruit load per vine in watermelon hybrid seed production.

Keywords Watermelon, Fruit load, Growth regulator, Ethrel.

Introduction

Watermelon (*Citrullus lanatus* (Thunb.) Matsum. and Nakai) belongs to family Cucurbitaceae. Cucurbits are among the economically most important vegetable crops worldwide and are grown in both temperate and tropical regions. In India, cucurbits are regarded as an important source of vegetables and desserts. Cultivation of watermelon is now widespread in all tropical and sub-tropical regions of the world and is mostly grown for fresh consumption of the juicy and sweet flesh of mature fruit. In Indian sub-continent, it is being grown during summer months as a cash crop under assured irrigation as well as on conserved moisture in river beds of Indo-Gangetic plains for its fresh dessert fruits commonly known as Tarbuj. The Tarbuj fruits can be seen on road side across the country from north to south and east to west during summer months (April to June). In Karnataka State, both improved varieties and hybrids are cultivated as desert vegetable crop for table purpose owing to their nutritious fruits. Generally, farmers prefer hybrids to other high yielding varieties for cultivation owing to their high yielding ability and profit. However, the productivity of watermelon crop needs to be enhanced by standardizing the seed production techniques like

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application growth regulators and fruit load for getting higher seed yield and quality.

In watermelon hybrid seed production, the number of developing fruits retained on the female parent after crossing will influence not only seed yield but also quality of seeds harvested. Higher the number of fruits retained on the vine, more is the seed yield but lower is the quality of seeds. On the contrary, the reverse trend of low yield resulting in better quality seeds could be obtained by retaining less fruit load on plants. Being a monoecious cucurbit, watermelon usually produces more number of male flowers than female and further initiation of male flowers is also early. As number of female flower contribute to total seed yield, the shift towards femaleness would certainly increase the final yield and quality of seeds. Plant growth regulator like GA_3 is known to regulate sex expression by suppressing production of male flowers by promoting the female flower production on the female parent of hybrid watermelon. Studies pertaining to effect of fruit load and growth regulators on seed yield and quality are meager in watermelon hybrid seed production. Hence, an investigation was conducted with an objective to know the influence of fruit load and growth regulators on seed yield and quality in hybrid watermelon seed production.

Materials and Methods

The field and laboratory investigations were carried out to find out the effect of fruit load and growth regulators on F_1 hybrid seed yield and quality in watermelon at Agricultural Research Station, Kawadimatti, University of Agricultural Sciences, Raichur, Karnataka. The required seed materials of female parent IIHR-20 and male parent Crimson Red of hybrid watermelon Arka Jyothi were obtained from Division of Vegetable Crops, Indian Institute of Horticultural Research, Hesaragatta, Bengaluru. The experiment was conducted in randomized block design (RBD) with two factorial concept (four fruit load levels as main factor and five growth regulators as sub factor) in three replications. The treatment details are as follows.

Factor I- Fruit load per vine (L) ; L_1 : Two fruits retained per vine, L_2 : Three fruits retained per vine, L_3 : Four fruits retained per vine, L_4 : All fruits retained per vine. Factor II-Growth regulators (G) ; G_1 : No spray (water spray), G_2 : GA_3 @ 25 ppm, G_3 : Ethrel @ 250 ppm, G_4 : TIBA @ 500 ppm, G_5 : CCC @ 500 ppm.

The crop was cultivated by following recommended package of practices. The emasculation work was carried out in the female parental block of hybrid watermelon experimental plot in the previous day evening hours. In the female IIHR-20 plants, emasculation was done manually by pinching off fully developed male buds from the vines. Further, only pistillate buds likely to open next day were bagged with butter paper bags for easy identification and were crossed manually with pollens of male parent in next day morning hour.

Method of foliar sprayings

The solutions of growth regulators were sprayed to the experimental plot as per treatment schedule explained above. The spraying was taken up by using Knapsack sprayer during evening hours at fruit initiation stage and it was sprayed with until all plants were fully drenched with the test solutions. The precaution was taken to prevent drifting away of spray solutions from one treatment plot to the other plot by covering with tarpaulin sheet.

The hybrid seed crop was harvested when the fruits were fully matured i.e. when they started showing the symptoms of petiole drying, paling of fruit, resonance metallic sound and brown color formation. Such harvested fruits were stored for 10 days for over ripening and further seeds were extracted manually by slicing the ripened fruits into small pieces and squeezing the fruit pulp and seeds were separated out. Then, they were further cleaned with fresh water dried under shade for five to six days to around eight per cent moisture content.

Collection of biometrical observations

Fruit yield (kg) per vine : All the fully ripened fruits

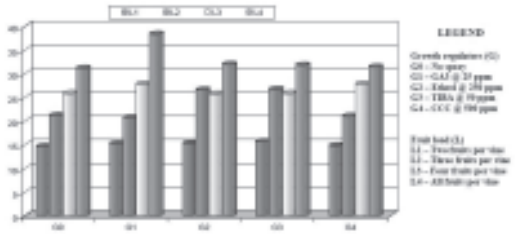

Fig. 1. Effect of growth regulators and fruit load on fruit yield (kg) per vine in hybrid watermelon Arka Jyothi.

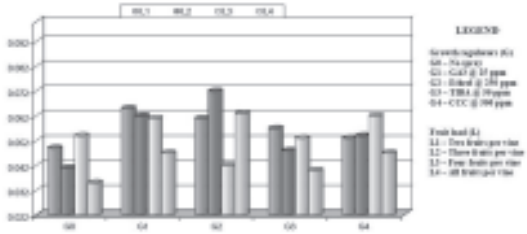

Fig. 2. Effect of growth regulators and fruit load on seed recovery percentage in hybrid watermelon Arka Jyothi.

harvested treatment wise from the five tagged vines and they were weighed using an electronic weighing balance and their average weight was expressed as fruit yield in kilograms per vine.

Table 1. Effect of growth regulators and fruit load on number of seeds per fruit in hybrid watermelon Arka Jyothi.

	Number of seeds per fruit									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	29.55	42.10	48.60	37.50	39.44	45.60	42.60	49.70	39.90	44.45
G_1– GA_3 @ 25 ppm	43.50	46.90	52.85	40.25	45.88	45.20	47.40	54.00	41.00	46.90
G_2– Ethrel @ 250 ppm	50.05	59.35	63.45	41.85	53.67	50.70	59.90	64.80	43.20	54.65
G_3– TIBA @ 50 ppm	38.80	41.75	48.45	37.00	41.50	40.00	42.80	49.30	38.00	42.52
G_4– CCC @ 500 ppm	40.20	42.20	47.90	36.75	41.76	41.20	43.20	48.90	37.90	42.80
Mean	40.42	46.46	52.25	38.67	44.45	44.54	47.18	53.34	40.00	46.26
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	1.98		5.84		0.65		1.93			
L	1.77		5.22		0.58		1.72			
G × L	3.96		NS		1.30		NS			

Table 1. Continued.

	Number of seeds per fruit				
	Pooled				
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	37.58	42.35	49.15	37.33	41.94
G_1– GA_3 @ 25 ppm	44.35	47.15	53.43	40.63	46.39
G_2– Ethrel @ 250 ppm	50.38	59.62	64.13	42.52	54.16
G_3– TIBA @ 50 ppm	39.40	42.27	48.87	37.50	42.01
G_4– CCC @ 500 ppm	40.70	42.70	48.40	38.70	42.28
Mean	42.48	46.82	52.79	39.34	45.35
For comparing the mean of					
	SEm±		CD at 5%		
G	0.51		1.52		
L	1.02		2.94		
G × L	1.45		NS		

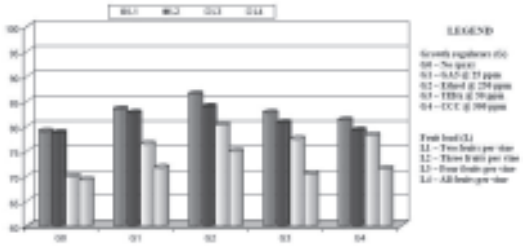

Fig. 3. Effect of growth regulators and fruit load on seed germination percentage in hybrid watermelon Arka Jyothi.

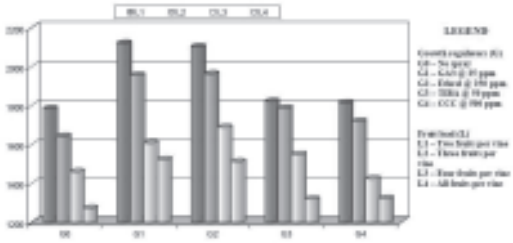

Fig. 4. Effect of growth regulators and fruit load on seedling vigor index in hybrid watermelon Arka Jyothi.

Number of seeds per fruit : In each of the treatments, the five normal fruits from the tagged vines were chosen randomly and their seeds were extracted manually from the tagged fruits by slicing and squeezing method. The total number of matured and immatured seeds extracted from each fruits was counted manually and their mean was expressed as total number of seeds per fruit.

Seed weight per fruit (g) : The total number of seeds extracted from each fruit were weighed on an electronic precision balance and their average weight was expressed as seed weight in grams per fruit.

Hundred seed weight : One hundred seeds from each treatment in eight replications were counted manually and their weight was recorded by using electronic precision analytical balance as per ISTA procedures. The average weight was expressed in grams as 100 seed weight.

Seed quality parameters

Seed germination (%) : Hundred seeds were drawn at random from each treatment in four replications and the standard germination test was conducted in the laboratory by using between paper method as per ISTA procedure. The rolled paper towels were placed in slant position in a laboratory germination cabinet where the 27±1°C temperature and the relative humidity at 95 ± 1% were maintained. The total number of normal seedlings emerged at the end of 12th day were counted and the average was expressed as seed germination in percentage.

Shoot length (cm) : At 12th day of germination testing, the ten normal seedlings were randomly selected for measurement of shoot length. It was measured on metric scale from collar region to the base of the primary leaf of the individual seedlings. The average was worked out and expressed as shoot length in centimeter.

Root length (cm) : The ten normal seedlings which were used for measuring shoot length were also used for measuring root length. The root length was measured from collar region to the tip of the primary root of the selected seedlings. The mean root length was expressed in centimeter.

Seedling vigor index (SVI) : The seedling vigor index was computed for each treatment by adopting the formula as suggested earlier and it was expressed in whole number by using following formula :

$$\text{Seedling vigor index} = \text{Germination (\%)} \times (\text{Shoot length} + \text{root length in cm})$$

Seedling dry weight (mg) : The ten normal seedlings selected earlier for shoot and root length measurement were kept in butter paper packets and were dried in a oven at 75 ± 1°C for 24 h. After end of drying period, seedlings were cooled in desiccator and weighed on an analytical precision balance and their mean weight was expressed in milligrams as seedling dry weight.

Table 2. Effect of growth regulators and fruit load on seed weight (g) per fruit in hybrid watermelon Arka Jyothi. Fruit load (L) : L_1–Two fruits per vine, L_2–Three fruits per vine, L_3–Four fruits per vine, L_4–All fruits per vine.

	Seed weight (g) per fruit									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	3.75	3.82	2.85	2.77	3.36	3.80	3.80	2.90	2.65	3.88
G_1– GA_3 @ 25 ppm	4.92	4.44	4.15	3.05	4.14	4.80	4.30	4.00	2.95	4.01
G_2– Ethrel @ 250 ppm	5.05	4.67	4.52	3.90	4.53	5.00	4.65	4.50	3.80	4.48
G_3– TIBA @ 50 ppm	4.25	3.87	3.45	2.77	3.59	4.25	3.80	3.40	2.75	3.55
G_4– CCC @ 500 ppm	4.10	4.37	3.87	3.02	3.78	4.05	4.30	3.80	3.05	3.70
Mean	4.42	4.23	3.77	3.10	3.88	4.38	4.17	3.72	3.04	3.82
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.04		0.13		0.04		0.14			
L	0.04		0.12		0.04		0.12			
G × L	0.09		0.26		0.09		0.28			

Table 2. Continued.

	Seed weight (g) per fruit				
			Pooled		
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	3.78	3.82	2.87	2.72	3.38
G_1– GA_3 @ 25 ppm	4.86	4.36	4.07	3.01	4.07
G_2– Ethrel @ 250 ppm	5.03	4.67	4.52	3.86	4.52
G_3– TIBA @ 50 ppm	4.27	3.85	3.43	2.77	3.58
G_4– CCC @ 500 ppm	4.07	4.33	3.85	3.03	3.74
Mean	4.40	4.21	3.75	3.08	3.86
For comparing the mean of					
		SEm±	CD at 5%		
G		0.009	0.02		
L		0.03	0.09		
G × L		0.04	0.13		

Field emergence (%) : One hundred seeds in four replications were taken randomly and sown in the specially prepared land for this purpose. On the 21th day field emergence was recorded. The average was calculated and expressed in percentage.

Statistical analysis : The analysis of variance and interpretation of data were done as per the standard procedures. Levels of significance used in *F* test was $p = 0.05$. Critical difference (CD) values were calculated only whereever the *F* test was found significant.

Results and Discussion

Effect of growth regulators on fruiting, seed yield and its attributes

Irrespective of the fruit load per vine, marked variations of the fruiting and seed yield components were noticed due to the spraying of different growth regulators. These results indicated that highest fruit weight, fruit yield per vine, seed recovery percentage, number of seeds per fruit and seed weight per fruit were obtained with foliar spray of ethrel @ 250

Table 3. Effect of growth regulators and fruit load on 100 seed weight (g) in hybrid watermelon Arka Jyothi.

	100 seed weight (g)									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	7.20	6.80	5.65	5.35	6.27	7.10	6.75	5.55	5.25	6.20
G_1– GA_3 @ 25 ppm	8.00	7.65	7.00	5.35	7.00	7.95	7.57	7.02	5.32	6.96
G_2– Ethrel @ 250 ppm	9.00	7.50	6.90	6.00	7.35	8.95	7.45	6.90	6.02	7.33
G_3– TIBA @ 50 ppm	7.35	6.85	6.40	5.42	6.48	7.20	6.82	6.32	5.40	6.40
G_4– CCC @ 500 ppm	8.50	7.40	6.30	5.55	6.93	8.30	7.22	6.25	5.40	6.79
Mean	8.01	7.24	6.45	5.54	6.81	7.90	7.17	6.41	5.48	6.74
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.08		0.25		0.08		0.25			
L	0.07		0.22		0.07		0.22			
G × L	0.17		0.51		0.17		0.50			

Table 3. Continued.

	100 seed weight (g)				
			Pooled		
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	7.15	6.77	5.60	5.30	6.23
G_1– GA_3 @ 25 ppm	7.97	7.61	7.01	5.33	6.98
G_2– Ethrel @ 250 ppm	8.97	7.48	6.90	6.01	7.34
G_3– TIBA @ 50 ppm	7.27	6.83	6.36	5.42	6.44
G_4– CCC @ 500 ppm	8.40	7.31	6.27	5.47	6.86
Mean	7.95	7.20	6.43	5.51	6.77
For comparing the mean of					
		SEm±	CD at 5%		
G		0.007	0.12		
L		0.06	0.17		
G × L		0.08	0.25		

ppm (7.32 kg, 25.59 kg, 0.059%, 54.16 and 4.52 g, respectively) (G_2). It was followed by GA_3 @ 25 ppm as compared to water spray (control) (G_0) (6.78 kg, 23.24 kg, 0.048%, 41.94 and 3.38 g) (Figs 1, 2).

The marked increase in number of seeds per fruit and seed weight per fruit recorded with ethrel @ 250 ppm spray may be attributed to higher fruit weight and number of filled seeds per fruit as noticed in this study. These findings are further supported by heavier build up of sufficient food reserves in the developing fruits and seeds in the physiologically active vines and hence it increased the supply of photosynthates and mobilization efficiency in vines giving rise to more and well developed seeds per fruit leading to higher seed yield per vine. These results are in agreement with the findings of other scientists in tomato, bittergourd and brinjal [1–5].

Effect of growth regulators on seed quality parameters

The seed quality parameters such as 100 seed weight, seed germination, shoot length, root length seedling vigor index, dry weight of seedling and field emer-

Table 4. Effect of growth regulators and fruit load on shoot length (cm) in hybrid watermelon Arka Jyothi. Fruit load (L) : L_1– Two fruits per vine, L_2–Three fruits per vine, L_3–Four fruits per vine, L_4–All fruits per vine.

	Shoot length (cm)									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	13.15	12.65	11.00	10.75	11.88	13.05	12.40	10.80	10.70	11.73
G_1– GA_3 @ 25 ppm	14.50	13.95	12.55	12.20	13.30	14.15	13.75	12.35	12.00	13.06
G_2– Ethrel @ 250 ppm	15.35	14.65	12.30	12.90	13.80	15.20	14.50	12.30	12.80	13.70
G_3– TIBA @ 50 ppm	12.60	13.80	11.95	10.75	12.27	12.40	13.70	11.80	10.60	12.12
G_4– CCC @ 500 ppm	13.70	12.55	12.35	10.90	12.37	13.50	12.40	12.30	10.60	12.20
Mean	13.86	13.52	12.03	11.50	12.72	13.66	13.35	11.91	11.34	12.56
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.12		0.36		0.12		0.36			
L	0.11		0.33		0.11		0.32			
G × L	0.25		0.73		0.24		0.72			

Table 4. Continued.

	Shoot length (cm)				
			Pooled		
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	13.10	12.52	10.90	10.72	11.81
G_1– GA_3 @ 25 ppm	14.32	13.85	12.45	12.10	13.18
G_2– Ethrel @ 250 ppm	15.27	14.57	12.30	12.85	13.75
G_3– TIBA @ 50 ppm	12.50	13.75	11.87	10.67	12.20
G_4– CCC @ 500 ppm	13.60	12.47	12.32	10.75	12.28
Mean	13.76	13.43	11.97	11.42	12.64
For comparing the mean of					
		SEm±	CD at 5%		
G		0.04	0.11		
L		0.08	0.25		
G × L		0.12	0.35		

gence exhibited marked variations due to application of growth regulators over the fruit load. All these quality parameters were significantly maximum in ethrel @ 250 ppm (7.34 g, 81.44%, 13.75 cm, 9.08 cm, 1817, 21.96 mg and 78.63%, respectively) (G_2) followed by GA_3 @ 25 ppm followed by GA_3 @ 25 ppm and TIBA 30 ppm least. Whereas, they were the lowest in the water spray (control) (G_0) (6.23 g, 74.25%, 11.81 cm, 8.16 cm, 1553, 19.02 mg and 71.94%, respectively) (Figs 3, 4). The significant increase in seed quality parameters obtained due to spraying of ethrel @ 250 ppm may be due to higher percentage of bolder seeds coupled with the heavier seed weight due to increased translocation and assimilation of photosynthates from source to the sink (seeds). Similar findings are also reported by other workers [2, 3, 5] in brinjal and in bittergourd. From these results, it can be inferred that higher better seed yield and quality seeds could be obtained by foliar spraying of ethrel @ 250 ppm and at the time of fruit formation stage.

Effect of fruit load on fruit, seed yield and their components

Marked variations in various fruiting and seed yield components were noticed due to the retention of vari-

Table 5. Effect of growth regulators and fruit load on root length (cm) in hybrid watermelon Arka Jyothi.

	Root length (cm)									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	8.95	8.25	7.85	7.70	8.22	8.80	8.20	7.70	7.60	8.11
G_1– GA_3 @ 25 ppm	10.05	9.45	8.65	8.15	9.07	9.90	9.70	8.55	8.00	9.03
G_2– Ethrel @ 250 ppm	10.25	9.15	8.80	8.50	9.17	10.00	9.00	8.65	8.30	8.98
G_3– TIBA @ 50 ppm	9.55	8.45	8.15	8.05	8.55	9.50	8.35	8.10	8.05	8.50
G_4– CCC @ 500 ppm	9.40	9.40	8.10	7.85	8.65	9.35	9.35	7.95	7.75	8.56
Mean	9.64	8.94	8.31	8.05	8.73	9.51	8.92	8.19	7.94	8.64
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.09		0.28		0.09		0.28			
L	0.08		0.25		0.08		0.25			
G × L	0.19		NS		0.19		NS			

Table 5. Continued.

	Root length (cm)				
			Pooled		
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	8.87	8.22	7.77	7.65	8.16
G_1– GA_3 @ 25 ppm	9.97	9.57	8.60	8.07	9.05
G_2– Ethrel @ 250 ppm	10.12	9.07	8.72	8.40	9.08
G_3– TIBA @ 50 ppm	9.52	8.40	8.12	8.05	8.52
G_4– CCC @ 500 ppm	9.37	9.37	8.02	7.80	8.60
Mean	9.57	8.93	8.25	7.99	8.68
For comparing the mean of					
		SEm±	CD at 5%		
G		0.02	0.44		
L		0.06	0.18		
G × L		0.09	NS		

able number of crossed fruits per vine (fruit load) irrespective of growth regulators used in the both years of experimentations as well as in pooled analysis. At harvest, fresh fruit weight and seed weight per fruit decreased progressively with increasing fruit load per vine from two fruits per vine (L_1) to all fruits load per vine (L_4) (Fig. 1, Table 1). This may be due to more translocation and assimilation of photosynthates from source to the developing fruits (sink) in the less fruit load per vine. While, fruit yield per vine increased reciprocally with the increase in fruit load per vine, this increase in fruit load may be related to the more number of fruits retained and seed number per vine. Whereas, the number of seeds per fruit and number of filled seeds per fruit were found to increase from two fruit load to four fruit load per vine and thereafter they decreased drastically in all fruit load per vine (Table 2). Further, it is observed that, the retention of all fruits per vine recorded the lowest fresh fruit weight, seed number per fruit, number of filled seeds per fruit and fruit yield per vine as compared to two fruit loads. This may be attributed to decreased availability and distribution of photosynthates in view of increased competition between the developing fruits due to higher fruit load per vine and it resulted poor development of fruit and seeds as compared to those of

Table 6. Effect of growth regulators and fruit load on seedling dry weight (mg) in hybrid watermelon Arka Jyothi. Fruit load (L) : L_1–Two fruits per vine, L_2–Three fruits per vine, L_3–Four fruits per vine, L_4–All fruits per vine.

	Seedling dry weight (mg)									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	19.50	19.55	18.70	18.05	18.98	19.80	19.50	18.70	18.00	19.06
G_1– GA_3 @ 25 ppm	22.10	21.70	19.65	19.45	20.72	22.10	21.65	19.60	19.60	20.73
G_2– Ethrel @ 250 ppm	23.90	22.70	21.00	20.25	21.96	23.85	22.80	21.05	20.20	21.97
G_3– TIBA @ 50 ppm	20.00	19.90	19.05	19.20	19.53	20.10	19.80	19.10	19.50	19.62
G_4– CCC @ 500 ppm	21.80	20.05	18.50	18.20	19.60	21.85	19.95	18.35	18.25	19.53
Mean	21.46	20.78	19.38	19.03	20.16	21.54	20.74	19.36	19.11	20.18
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.16		0.48		0.14		0.43			
L	0.14		0.43		0.13		0.39			
G × L	0.32		0.96		0.29		0.87			

Table 6. Continued.

	Seedling dry weight (mg) Pooled				
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	19.65	19.52	18.70	18.02	19.02
G_1– GA_3 @ 25 ppm	22.10	21.67	19.62	19.52	20.73
G_2– Ethrel @ 250 ppm	23.87	22.75	21.02	20.22	21.96
G_3– TIBA @ 50 ppm	20.05	19.85	19.07	19.35	19.58
G_4– CCC @ 500 ppm	21.82	20.00	18.42	18.22	19.56
Mean	21.50	20.76	19.37	19.07	20.17
For comparing the mean of					
		SEm±	CD at 5%		
G		0.03	0.09		
L		0.10	0.30		
G × L		1.14	3.42		

lower fruit load per vine. These results are also confirmed with findings of similar line of studies [3, 5–7].

Effect of fruit load on seed quality parameters

The retention of variable number of fruit load per vine exhibited significant differences of various seed quality parameters irrespective of growth regulators. In general, 100 seed weight, seed germination, shoot length, root length, seedling dry weight, seedling vigor index and field emergence decreased linearly as the fruit load increased from two fruits to all fruits per vine. All these seed quality parameters were significantly maximum (7.95g, 82.60%, 13.76 cm, 9.57 cm, 1929, 21.50 mg and 77.35%, respectively) in the two fruit load per vine and it was followed by three and four fruit load per vine. Whereas, they were significantly lower (5.51 g, 71.60%, 7.99 cm, 11.42 cm, 1391, 19.07 mg and 71.75%, respectively) in all fruit load per vine (Figs 3, 4) and (Tables 3–7).

The better seed quality noticed in two fruit load per vine followed by three and four loads may be due to higher seed recovery and number of filled seeds

Table 7. Effect of growth regulators and fruit load on field emergence (%) in hybrid watermelon Arka Jyothi. Fruit load (L) : L_1–Two fruits per vine, L_2–Three fruits per vine, L_3–Four fruits per vine, L_4–All fruits per vine.

	Field emergence (%)									
	I year					II year				
Treatments	L_1	L_2	L_3	L_4	Mean	L_1	L_2	L_3	L_4	Mean
G_0– No spray	71.00	73.50	74.50	68.50	71.88	70.50	73.50	75.00	69.00	72.00
G_1– GA_3 @ 25 ppm	80.50	77.50	73.50	71.50	75.75	81.00	76.50	73.00	72.00	75.63
G_2– Ethrel @ 250 ppm	82.50	80.50	77.00	75.00	78.75	82.50	81.50	76.00	74.00	78.50
G_3– TIBA @ 50 ppm	75.00	76.00	74.00	72.50	74.38	75.50	76.50	73.50	73.00	74.63
G_4– CCC @ 500 ppm	78.50	77.50	71.00	70.50	74.38	76.50	77.50	71.50	71.50	74.25
Mean	77.50	77.00	74.00	71.60	75.02	77.20	77.10	73.80	71.90	75.00
For comparing the mean of										
	SEm±		CD at 5%		SEm±		CD at 5%			
G	0.47		1.40		0.49		1.47			
L	0.42		1.26		0.44		1.32			
G × L	0.95		2.81		0.99		2.95			

Table 7. Continued.

	Field emergence (%)				
			Pooled		
Treatments	L_1	L_2	L_3	L_4	Mean
G_0– No spray	70.75	73.50	74.75	68.75	71.94
G_1– GA_3 @ 25 ppm	80.75	77.00	73.25	71.75	75.69
G_2– Ethrel @ 250 ppm	82.50	81.00	76.50	74.50	78.63
G_3– TIBA @ 50 ppm	72.25	76.25	73.75	77.75	74.50
G_4– CCC @ 500 ppm	77.50	77.50	71.25	71.00	74.31
Mean	77.35	77.05	73.90	71.75	75.01
For comparing the mean of					
	SEm±		CD at 5%		
G	0.22		0.66		
L	0.33		0.96		
G × L	0.47		1.36		

and seed weight as seen from the present study. Whereas, retained all fruits per vine recorded the poor quality seeds due to less seed recovery, filled seeds and seed weight. These results are in confirmation with findings of other scientists in various crops [3, 5–9]. It can be inferred from above results, that the best quality seeds could be obtained with the two fruit load per vine followed by three and four fruit loads in watermelon hybrid seed production.

Interaction effect

Significant and consistent differences due to interaction between growth regulators and fruit load per vine were observed for fruiting and seed yield components. The interaction of L_2G_2 and G_2L_1 recorded consistently maximum fruit weight (8.22 kg) and seed weight (5.03 g) per fruit followed by G_2L_2 and G_1L_1. Whereas, maximum fruit yield per vine was obtained in interaction of G_1L_4 followed by G_2L_4 and G_3L_4. This may be due to retention of more fruits per vine as compared to control (water spray) (G_0L_1). However, the number of seeds per fruit and filled seeds per fruit were significantly highest in the interaction of G_2L_2 followed by G_2L_1 and G_1L_2 as against water spray (control). This increase in seed number may be attributed to spraying of growth regulators and also lower fruit number per vine. Further, the growth regulators might

have increased in the fruit weight as seen in the present study. The various seed quality parameters were found to differ significantly due to interaction between growth regulators and fruit load. The 100 seed weight, seed germination, root length, shoot length, seedling vigor index, dry weight of seedling and field emergence were significantly highest in the interaction of G_2L_1 followed by G_2L_2, G_1L_1 and G_1L_2 as compare to control (water spray) G_0L_4.

The better seed quality traits noticed in these interaction effect may be attributed to the increased translocation and assimilation of photosynthates from source to sinks and it has further resulted in recovery of more filled seeds percentage and seed weight coupled with lower fruit load per vine in the interaction of G_2L_1 followed by G_1L_2 and G_1L_1 interactions. These results are in collaborative with findings of other workers [2, 3, 7]. The overall results indicated better seed quality could be obtained by spraying ethrel @ 250 ppm and retention of two fruits per vine in hybrid watermelon seed production. From these results, it can be stated that, consistently higher seed yield could be obtained by spraying ethrel @ 250 ppm at three fruit load per vine in watermelon hybrid seed production.

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