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Effect of nutrients and growth regulators on fruit drop, size and yield of ber (*Zizyphus mauritiana* Lamk.)

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ABSTRACT
The present investigation was conducted on nineteen-years-old trees of cultivar Umran growing at Ladhowal Farm of Punjab Agricultural University, Ludhiana. The different chemicals *viz.,* potassium sulphate (0.5, 1.0 and 1.5%), potassium nitrate (0.5, 1.0 and 1.5%), paclobutrazol (100, 200, 300 ppm) and NAA (20, 40 and 60 ppm) were sprayed at fruit set stage and at active growth phase along with a control. Maximum fruit retention and minimum fruit drop was recorded in the trees sprayed with 1.5 per cent potassium sulphate and 20 ppm NAA at fruit set stage. Higher fruit size in terms of length and breadth, weight and yield was recorded with 60 ppm NAA sprayed at active growth phase.

Key Words : Ber, Growth regulators**,** Nutrients, Fruit growth.

INTRODUCTION

Ber (*Zizyphus mauritiana* Lamk.) is an important fruit crop of arid and semi-arid regions of tropical and subtropical areas due to its wider adaptability to adverse soil and climatic conditions. On the account of this, ber is also called as 'the apple of arid zone'. In India, there is about 87,700 ha area under cultivation and major ber growing states are Rajasthan, Gujarat, Madhya Pradesh, Punjab, Haryana, Uttar Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, West Bengal and Assam. Its cultivation is quite successful in Punjab, Haryana and Rajasthan. In Punjab, ber ranks 4th in area after citrus, guava and mango and covers an area of 2669 ha with an annual production of 40,035 mt. 'Umran' ber is commercially cultivated due to its higher yield potential, large fruit size, attractive colour, good shipping quality and wider market acceptability. However, about 50% fruits of 'Umran' ber remain very small which adversely affects the yield and profit to the growers. The problem of fruit drop has been observed in ber and bulk of immature fruits dropped during initial stage of fruit growth and development due to various factors like hormonal imbalance, abortion of embryo and inclement weather (Singh *et al.,*1991).The present investigation was therefore planned with the objective to reduce the fruit drop and to improve the fruit size and yield of 'Umran' ber.

MATERIALS AND METHODS

The present investigation was conducted on nineteen-years-old trees of cultivar Umran growing at Ladhowal Farm of Punjab Agricultural University, Ludhiana. The different chemicals *viz.,* potassium sulphate (0.5, 1.0 and 1.5%), potassium nitrate (0.5, 1.0 and 1.5%), paclobutrazol (100, 200, 300 ppm) and NAA (20, 40 and 60 ppm) were sprayed at fruit set stage and at active growth phase along with a control. At fruit set stage, these chemicals were sprayed on 20th October, 2004. Again, the spray of these chemicals were superimposed on the same trees on 23rd November, 2004. At active growth phase, these chemicals were sprayed on separate set of plants on 29th January, 2005. There are total 13 treatments and each treatment was replicated thrice. Four uniform branches per tree were selected and tagged randomly in different directions of plant to record per cent fruit retention and per cent fruit drop. The observations on fruit size (length and breadth), weight and yield per tree were recorded. The data on these observations were statistically analysed by Randomized Block Design with factorial arrangement.

RESULTS AND DISCUSSION

Fruit retention and Fruit drop

Maximum fruit retention (24.78%) was recorded with 1.5% potassium sulphate which was closely at par with 20 ppm NAA (24.75%) (Table 1). However, minimum fruit retention (16.58%) was found in control .The highest fruit retention (22.07%) was recorded with spray at fruit set stage instead at active growth phase (19.83%). Maximum fruit retention (31.10%) was found with 1.5% potassium sulphate followed by 20 ppm NAA (30.88%) and 300 ppm paclobutrazol (28.60%) sprayed at fruit set stage. Lower fruit retention was recorded in control i.e. 16.51 per cent and 16.55 per cent at active growth phase and at fruit set stage, respectively. Pandey (1999) and Bhati and Yadav (2004) also reported the increase in fruit retention with 20 ppm NAA in Banarasi Karaka (10.30%) and Gola (55.11%) cultivars of ber.

All the potassium sulphate and NAA treatments significantly reduced the fruit drop (Table 1). However, the lowest fruit drop of 75.22 per cent and 75.25 per cent was recorded with 1.5% potassium sulphate and 20 ppm NAA, respectively. The fruit drop in ber firstly, may be due to the abortion of embryo (Singh and Singh**,** 1976) and Secondly, may be due to pre-mature formation of an abcission layer in the stalk of ripe and nearly ripe fruits. The highest fruit drop (83.42%) was recorded in control followed by 1.5% potassium nitrate (82.30%) and 200 ppm paclobutrazol (82.11%). Minimum fruit drop was recorded when spraying was done at fruit set stage (77.93%) than the spraying at active growth phase (80.17%). The lowest fruit drop (68.90%) was recorded with 1.5% potassium sulphate followed by 20 ppm NAA (69.12%) sprayed at fruit set stage. Reduction in the fruit drop in 'Umran' ber with 20 ppm NAA was also reported by Singh *et al.* (2001).

Fruit size

All the NAA treatments resulted in significant increase in fruit length (Table 2). However, maximum fruit length (4.51 cm) was recorded with 20 ppm NAA followed by 60 ppm NAA (4.50cm) and 40 ppm NAA (4.44cm). Minimum fruit length (4.22cm) was recorded in the control. The above results are in agreement with the findings of Bal *et al.* (1984), Singh and Randhawa (2001) and Bhati and Yadav (2004). The spray of NAA might have raised the auxin level in fruit which ultimately helped in the development of its various components as there is direct correlation between auxin content and fruit growth in several plants (Krishnamoorthy, 1981). Greater fruit length (4.50 cm) was found with the spray at active growth phase than the spray at fruit set stage (4.29cm). All the paclobutrazol treatments and 20 ppm NAA sprayed at active growth phase resulted the considerable increase in fruit length. However, the longest fruits (4.63cm) were obtained with 200 ppm paclobutrazol sprayed at active growth phase.

No significant difference in the fruit breadth was observed among the different treatments (Table 2). However, maximum fruit breadth (3.13 cm) was noted in 100 ppm paclobutrazol treated fruits and minimum fruit breadth (2.90cm) was recorded in control. Slightly broader fruits were obtained with the active growth phase spray (3.08 cm) than the fruit set stage spray (2.99 cm). Maximum fruit

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Table 1: Effect of nutrients and growth regulators on fruit retention (%)and fruit drop (%) of 'Umran' ber.

Treatments	Fruit retention			Fruit drop		
	FSS	AGP	Mean	FSS	AGP	Mean
Potassium sulphate 0.5%	17.15	26.01	21.58	82.85	73.99	78.42
Potassium sulphate 1.0%	17.13	25.34	21.23	82.87	74.66	78.77
Potassium sulphate 1.5%	31.10	18.47	24.78	68.90	81.53	75.22
Potassium nitrate 0.5%	22.83	20.75	21.79	77.17	79.25	78.21
Potassium nitrate 1.0%	20.31	20.01	20.16	79.69	79.99	79.84
Potassium nitrate 1.5%	18.01	17.39	17.70	81.99	82.61	82.30
Paclobutrazol 100 ppm	26.70	17.28	21.99	73.30	82.72	78.01
Paclobutrazol 200 ppm	17.72	18.05	17.89	82.28	81.94	82.11
Paclobutrazol 300 ppm	28.60	17.43	23.02	71.40	82.57	76.98
Naphthalene acetic acid 20 ppm	30.88	18.61	24.75	69.12	81.39	75.25
Naphthalene acetic acid 40 ppm	18.16	22.97	20.57	81.84	77.03	79.43
Naphthalene acetic acid 60 ppm	21.63	18.90	20.27	78.37	81.10	79.73
Control	16.65	16.51	16.58	83.35	83.49	83.42
Mean	22.07	19.83		77.93	80.17	
CD at 5% : Treatment(s) (A)	: 3.62			: Treatment(s) (A)	: 3.68	
: Spray stage (B)	: 1.42			: Spray stage (B)	: 1.44	
: Interaction (A x B)	: 5.12			: Interaction (A x B)	: 5.21	

FSS : Fruit set stage ; AGP : Active growth phase

Table 2: Effect of nutrients and growth regulators on fruit size of 'Umran' ber.

Treatments	Length (cm)			Breadth (cm)		
	FSS	AGP	Mean	FSS	AGP	Mean
Potassium sulphate 0.5%	4.37	4.45	4.41	3.00	3.11	3.06
Potassium sulphate 1.0%	4.50	4.49	4.49	3.07	3.04	3.05
Potassium sulphate 1.5%	4.23	4.51	4.37	2.90	3.01	2.96
Potassium nitrate 0.5%	4.33	4.37	4.35	3.05	3.09	3.07
Potassium nitrate 1.0%	4.33	4.37	4.35	3.03	3.13	3.08
Potassium nitrate 1.5%	4.40	4.50	4.45	3.03	3.01	3.02
Paclobutrazol 100 ppm	4.07	4.61	4.34	3.10	3.16	3.13
Paclobutrazol 200 ppm	4.10	4.63	4.37	2.92	3.10	3.01
Paclobutrazol 300 ppm	4.09	4.57	4.33	2.97	3.10	3.03
Naphthalene acetic acid 20 ppm	4.43	4.58	4.51	3.05	3.08	3.06
Naphthalene acetic acid 40 ppm	4.33	4.55	4.44	2.90	3.10	3.00
Naphthalene acetic acid 60 ppm	4.49	4.51	4.50	3.03	3.15	3.09
Control	4.10	4.33	4.22	2.83	2.97	2.90
Mean	4.29	4.50		2.99	3.08	
CD at 5% : Treatment(s) (A)	: 0.16			: Treatment(s) (A)	: NS	
: Spray stage (B)	: 0.06			: Spray stage (B)	: 0.05	
: Interaction (A x B)	: 0.23			: Interaction (A x B)	: NS	

breadth (3.16cm) was found with 100 ppm paclobutrazol sprayed at active growth phase and minimum fruit breadth (2.83cm) was found in control at fruit set stage although the results were non significant.

Fruit weight and Fruit yield

The highest fruit weight (24.51g) was recorded with the 60 ppm NAA followed by 20 ppm NAA (24.03g) (Table 3). The above results are also in line with the findings of Bal *et al.* (1982 and 1986), Pandey (1999), Singh and Randhawa (2001) and Bhati and Yadav (2004) in ber with the application of NAA. Minimum fruit weight (21.23g) was noted in control followed by 1.5% potassium sulphate (21.78g). The average fruit weight was found significantly higher in active growth phase spray (23.87g) than in fruit set stage spray (21.85g). All NAA treatments and 1.0% potassium nitrate sprayed at active growth phase was found significantly better than the most of the treatments applied during fruit set stage and active growth phase. However, maximum fruit weight (26.50g) was found with 60 ppm NAA sprayed at active growth phase.

The fruit yield was significantly increased (75.66 kg/tree) with 60 ppm NAA which was closely at par with 0.5% potassium nitrate (74.97 kg/tree) and 0.5% potassium sulphate (68.76 kg/tree) (Table 3). The highest fruit yield with 60 ppm NAA might be due to the increase in fruit weight with this treatment. The above results are in accordance with the findings of Pandey (1999), Singh *et al.* (2001), Singh and Randhawa (2001), Bhati and Yadav (2004) in ber with NAA treatment. The fruit yield was recorded significantly higher in active growth phase spray (59.41 kg/tree) than the fruit yield in fruit set stage spray (55.37 kg/tree). NAA at 60 ppm recorded the highest fruit yield (81.30 kg/tree) when trees were sprayed at active growth phase.

Table 3: Effect of nutrients and growth regulators on fruit weight (g) and fruit yield (kg/tree) of 'Umran' ber.

Treatments	Fruit weight			Fruit yield		
	FSS	AGP	Mean	FSS	AGP	Mean
Potassium sulphate 0.5%	22.73	22.83	22.78	60.35	77.16	68.76
Potassium sulphate 1.0%	22.32	23.39	22.85	57.35	59.27	58.31
Potassium sulphate 1.5%	21.25	22.32	21.78	43.73	49.98	46.86
Potassium nitrate 0.5%	22.89	24.19	23.54	69.15	80.79	74.97
Potassium nitrate 1.0%	22.35	24.40	23.37	46.11	70.24	58.18
Potassium nitrate 1.5%	20.63	24.02	22.32	54.19	53.95	54.07
Paclobutrazol 100 ppm	22.51	24.12	23.32	65.80	49.17	57.48
Paclobutrazol 200 ppm	22.23	22.96	22.59	44.90	49.62	47.26
Paclobutrazol 300 ppm	22.32	22.31	22.31	57.12	40.56	48.84
Naphthalene acetic acid 20 ppm	21.92	26.14	24.03	65.09	48.36	56.73
Naphthalene acetic acid 40 ppm	20.00	24.99	22.49	36.70	60.23	48.47
Naphthalene acetic acid 60 ppm	22.53	26.50	24.51	70.02	81.30	75.66
Control	20.34	22.12	21.23	49.30	51.69	50.50
Mean	21.85	23.87		55.37	59.41	
CD at 5% : Treatment(s) (A) :	1.61			: Treatment(s) (A)	: 9.57	
: Spray stage (B) :	0.63			: Spray stage (B)	: 3.75	
: Interaction (A x B):	2.28			: Interaction (A x B)	: 13.53	

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