Environment & Ecology 29 (2) : 627—631, 2011
 ISSN 0970-0420

Fruit Retention, Yield and Leaf Nutrient Content of Ber as Influenced by Foliar Application of Nutrients and Growth Regulators

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Abstract

Foliar application of nutrients (urea 1.0%, $ZnSO_4$ 0.5% and potassium sulfate 1.0%) and growth regulators (GA_3 50 ppm and NAA 20 ppm) significantly increased the fruit set, fruit retention and fruit yield of ber over control. Maximum fruit set (9.70 and 9.58%) and fruit yield (119.2 and 103.5 kg/tree) were obtained with foliar application of 0.5% zinc sulfate, closely followed by 20 ppm NAA treatment during 2002 and 2003, respectively. These treatments significantly reduced the fruit drop also and obviously increased fruit retention. However, potassium sulfate (1.0%) was not found effective for fruit set and fruit retention. Three numbers of sprays of these chemicals (at flower initation, 20 and 40 days after first spray) were found effective in increasing the fruit retention and yield. Leaf P and K contents increased by potassium sulfate (1.0%) and NAA (20 ppm) but decreased by urea sprays. Nitrogen and zinc contents of leaf increased by foliar application of urea and zinc sulfate.
Key words : Growth regulators, Nutrients, Ber, Fruit set, Fruit retention

Ber (*Ziziphus mauritiana* Lamk.) is an important fruit of dry land regions. It is a rich source of vitamin C, proteins and amino acids, which are perhaps more than apple and orange. Among 180 named cultivars of ber in literature, Umran is being preferred the most by fruit growers due to its high yield potential, big fruit size, alternative color, good keeping quality and more income per unit area. However, during last one decade, numerous complaints have been received from ber growers regarding poor fruit set, excessive fruit drop and uneven fruiting in Umran. Foliar application of various nutrients and growth regulators has been reported to reduce fruit drop, increase fruit set, and yield in various fruit crops (1—3). Therefore, the present investigation was conducted to study the response of foliar application of various macro and micro nutrients and growth regulators on fruit set, retention, and yield of ber.

Methods

The investigation, comprising of foliar application of zinc sulfate (0.5%), urea (1.0%) , potassium sulfate (1.0%), GA_3 (50 ppm) and NAA (20 ppm), was carried out at experimental orchard of Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2001-02 and 2002-03. Uniform plants of ber cv Umran were selected for this study. All the treatments were replicated thrice taking one plant as a single unit in a randomized block design. The chemicals were sprayed on the whole tree at flower initiation stage, 20 and 40 days after first spray with a gatoor sprayer using teepol as surfactant. Uniform cultural practices were followed for these trees throughout the study period. Aqueous solutions of GA_3 and NAA were prepared by dissolving the chemicals in absolute alcohol and then the required volumes were made up with distilled water to make the stock solutions.

Fruit set was calculated by counting the number of flowers on eight tagged shoots and total number of fruits set. The fruit retained on these selected shoots were counted at maturity and per cent retention was calculated on the basis of total number of fruits set. Total fruit yield per tree was recorded at various intervals of harvesting.

Leaf samples for nutrient analysis were collected based on standard procedure (4) and after cleaning, drying, grinding and digestion nitrogen, phosphorus, potassium and zinc contents were estimated by

Table 1. Effect of chemicals and number of sprays on yield parameters of ber cv Umran.

Treat-ments	Fruit set (%) 2002	2003	Fruit retention (%) 2002	2003	Fruit yield (kg/tree) 2002	2003
GA_3 (50 ppm)						
1	7.27	7.82	53.6	40.6	94.0	88.9
2	7.53	7.99	54.4	41.2	98.6	89.1
3	7.32	8.44	53.9	43.4	100.6	90.2
Mean	7.34	8.08	54.0	41.7	99.8	89.4
NAA (20 ppm)						
1	9.50	9.24	55.8	50.9	109.3	100.7
2	9.51	9.62	59.6	53.4	118.0	101.7
3	9.67	9.47	61.9	54.6	120.7	102.6
Mean	9.56	9.45	59.1	53.0	116.0	101.4
$ZnSO_4$ (0.5%)						
1	9.11	9.47	57.9	51.4	113.5	98.4
2	9.86	9.80	60.3	54.8	120.7	107.0
3	10.11	9.46	62.0	55.5	123.3	105.2
Mean	9.70	9.58	60.1	53.9	119.2	103.5
Urea (1.0%)						
1	8.41	8.58	55.2	48.8	103.6	94.5
2	8.85	9.18	60.1	50.4	114.4	98.0
3	9.07	8.89	60.4	53.6	119.8	99.4
Mean	8.78	8.88	58.6	50.9	112.6	97.3
K_2SO_4 (1.0%)						
1	7.20	7.57	53.3	39.0	98.1	89.0
2	7.22	7.48	51.0	39.3	100.0	91.0
3	7.45	7.62	51.5	40.8	101.1	90.7
Mean	7.29	7.56	51.9	39.7	99.7	90.2
Control (Water)						
1	7.12	7.43	51.5	39.4	96.2	85.5
2	7.14	7.51	50.9	38.9	95.4	85.6
3	7.10	7.59	52.0	39.5	97.0	85.4
Mean	7.12	7.51	51.5	39.3	96.2	85.5
$CD_{0.05}$						
Chemicals	0.18	0.22	1.1	1.9	3.3	3.1
No. of sprays	0.13	0.15	0.8	1.3	2.4	2.2
Chmicals × sprays	NS	NS	NS	NS	NS	5.4

standard prescribed methods.

Results and Discussion

Table 1 shows that foliar application of chemicals and number of sprays significantly increased the fruit set over control during both the years, except potassium sulfate (1.0%). Maximum fruit set (9.70 and 9.58%) was recorded with the spray of zinc sulfate (0.5%) followed by NAA (9.56 and 9.45%), whereas, minimum fruit set (7.12 and 7.51%) was recorded under control during 2001 and 2002, respectively. Fruit retention was also significantly improved over control by foliar application of these chemicals at different stages. During the year 2002 maximum fruit retention of 60.1% was recorded under zinc sulfate treatment closely followed by NAA (20 ppm) treatment and minimum (51.5%) in control. Similar trend was observed during 2003. However, continuos foggy conditions during January 2003 caused heavy fruit drop, in general.

Further, during both the years,fruit yield was significantly increased by the foliar application of various nutrients and growth regulators over control (Table 1). Maximum yield (119.2 and 103.5 kg/tree) was obtained with the foliar application of 0.5% zinc sulfate during 2002 and 2003, respectively, whereas, minimum yields of 96.2 and 85.5 kg per tree were recorded under control during the respective years. However, the zinc sulfate treatment was statistically at par with 20 ppm NAA treatment in respect of yield during both the years. Zinc is reported to promote the synthesis of tryptophan, which serves as a precursor for auxin synthesis leading to increased fruit set and diminished fruit drop and thereby, increased retention of fruits (5). NAA, being an auxin, is directly related with fruit set and maintains the ongoing physiological and biochemical functions, as it moves to the abscission zone, where it maintains quiescent physiological characteristics and inhibits abscission. Increased fruit set and reduced fruit drop, as a result of these chemicals, gave higher number of fruits and ultimately the higher yields. These results are in conformity with the earlier findings (36,7). Increased number of sprays also increased fruit yield of ber due to increase in fruit set and decrease in fruit drop by continuous supply of nutrients and growth regulators required for fruit development. However, two num-

Table 2. Effect of chemicals and number of sprays on leaf nutrient contents of ber cv Umran.

Treatments	Nitrogen (%) 2002	Nitrogen (%) 2003	Phosphorus (%) 2002	Phosphorus (%) 2003	Potassium (%) 2002	Potassium (%) 2003	Zinc (ppm) 2002	Zinc (ppm) 2003
GA_3 (50ppm)								
1	2.07	2.19	0.217	0.223	1.04	1.10	13.2	14.7
2	2.05	2.22	0.224	0.231	1.01	1.14	14.0	15.9
3	2.02	2.21	0.220	0.230	0.99	1.11	12.7	15.4
Mean	2.05	2.21	0.220	0.228	1.01	1.12	13.3	15.3
NAA (20 ppm)								
1	2.11	2.21	0.239	0.255	1.07	1.17	13.2	15.6
2	2.15	2.31	0.257	0.252	1.11	1.15	12.7	14.7
3	2.10	2.28	0.255	0.261	1.08	1.21	13.2	17.3
Mean	2.12	2.26	0.250	0.256	1.08	1.18	13.1	15.9
$ZnSO_4$ (0.5%)								
1	2.15	2.25	0.220	0.232	0.97	1.01	16.9	20.6
2	2.17	2.23	0.217	0.235	1.02	0.99	20.5	24.6
3	2.15	2.31	0.227	0.237	1.00	1.02	24.3	28.8
Mean	2.16	2.26	0.221	0.235	1.00	1.01	20.6	24.7
Urea (1.0%)								
1	2.28	2.69	0.191	0.197	0.91	1.05	14.1	16.3
2	2.34	2.79	0.199	0.209	0.95	1.06	14.4	17.3
3	2.46	2.90	0.209	0.206	0.95	1.03	13.7	18.5
Mean	2.36	2.79	0.200	0.204	0.94	1.05	14.0	17.3
K_2SO_4 (1.0%)								
1	2.05	2.12	0.230	0.259	1.15	1.24	11.7	13.8
2	2.01	2.15	0.239	0.270	1.24	1.31	12.0	14.4
3	2.06	2.16	0.243	0.274	1.23	1.35	13.8	15.5
Mean	2.04	2.14	0.237	0.268	1.21	1.30	12.5	14.6
Control (Water)								
1	2.04	2.16	0.221	0.238	1.02	1.09	12.8	15.1
2	2.06	2.18	0.228	0.240	1.05	1.11	13.1	14.2
3	2.05	2.16	0.226	0.239	1.04	1.10	13.2	15.7
Mean	2.05	2.16	0.225	0.239	1.04	1.10	13.0	15.0
$CD_{0.05}$								
Chemicals	0.05	0.04	0.005	0.005	0.03	0.03	0.6	1.0
No. of sprays	NS	0.03	0.004	0.004	NS	NS	0.4	0.8
Chemicals × sprays	NS	NS	NS	NS	NS	NS	1.0	1.8

bers of sprays were found optimum. Likewise, it was earlier reported that spraying the apple trees two or three times a year with Zn, Mn and Fe sulfates was more effective than spraying once a year with respect to fruit yield (8).

Table 2 reveals that foliar application of various nutrients and growth regulators influenced the nutrient content of ber leaves. Nitrogen content of ber leaves increased with foliar spray of urea, zinc sulfate and NAA. During 2002, maximum leaf nitrogen content of 2.36% was recorded under 1.0% urea spray followed by 0.5 per cent zinc sulfate (2.16%) and 20 ppm NAA (2.12%) treatments, which were significantly higher than other chemical treatments including control. Similar trend was followed during 2003. The increase in leaf nitrogen content by foliar application of urea might be due to the absorption of good amount of urea by the leaves. Foliar application of zinc sulfate increased leaf N content which might be due to the reason that foliar application of zinc sulfate corrected zinc deficiency in the leaves and chlorotic leaves became normal, resulting in better assimilation of nitrogen in the leaves. Similar results have been reported by earlier workers (6,9). Increase in leaf N content by NAA may be due to the reason that hormones have marked effect on the dominance of natural metabolic sinks and may change the nutrient requirement of the plant, the uptake of nutrients into the plants, the movement and concentration of mineral nutrients into the plant (10).

Phosphorus content of ber leaves increased significantly by NAA (20 ppm) and pottassium sulfate (1.0%), which might be due to synergetic interaction of potassium and phosphorus and secondly, due to decrease in N content in potassium sulfate spray as reported in the present study. A significant decrease in leaf phosphorus content with foliar application of urea and GA_3 in the present study might be due to antagonistic interaction between N and P (11). Phosphorus and zinc interactions are well understood among micronutrients. These results are in agreement with the earlier findings (9). Foliar application of urea (1.0%) and zinc sulfate (0.5%) significantly decreased the potassium content of ber leaves during both the years. This decrease in potassium content of leaves by nitrogen application might be due to antagonistic interaction of nitrogen and potassium (11) in orange trees. Increased leaf nitrogen content in zinc sulfate treated trees may be the reason for decreased potassium content in the leaves. Similar decrease in leaf potassium content was also reported earlier (9) with urea and zinc sulfate sprays in ber. Increase in potassium content with potassium sulfate spray, in the present study; might be due to increased absorption of potassium by the leaves. NAA application also increased the leaf K content, however, it was not much altered by the GA_3 treatment during both the years. Zinc content of the ber leaves increased with the foliar application of zinc sulfate and urea. Maximum leaf zinc content of 20.6 and 24.7 ppm was recorded in 0.5% zinc sulfate treatment during 2002 and 2003, respectively. The effects of GA_3, NAA and potassium sulfate were statistically at par with control. But increase in zinc content of leaves with urea spray might be due to increased solubility of zinc as reported earlier in solo papaya (12). These results are in agreement with the earlier findings in ber (6). Leaf N, P and Zn contents were influenced significantly with the increased number of sprays, while two sprays were found optimum.

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