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Short communication

Effect of nitrogen, phosphorus and zinc on growth and yield of *ber* cv. Gola under arid and semi-arid conditions

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Ber (*Zizyphus mauritiana* Lamk.) is a cross-pollinated fruit plant of family Rhamnaceae. It is hardy and easily can be planted on pastured and undulated land where other fruit plants do not grow successfully. It is also grown in arid and semi-arid regions successfully and provides high yield and more income per unit area with low input.

High yield of fruits exhaust the plant and soil's essential elements needed for proper growth and development. Hence, various elements are required to be replenished regularly in sufficient quantity to keep the fruit tree in healthy and productive condition. Nitrogen is an important constituent of protoplasm and it is helpful in chlorophyll synthesis, these increase photosynthetic activity of *ber* leaves and consequently the fruits yield (Singh and Ahlawat, 6). The phosphorus is another major nutrient which is required for growth and development of plants. In addition to structural role of phosphorus in nucleic acid, nucleotides and phospholipids, it may essentially have regulatory functions in the photosynthesis and carbohydrate metabolism in leaves. It increased the efficiency of metabolic and physiological processes of plants and thus encouraged weight, yield and quality of *ber* fruits (Lal *et al.*, 4). Zinc availability is necessary for growth as it is reported to promote synthesis of indole acetic acid through tryptophan which serves as a precursor for auxin synthesis and directly affect the growth parameter of ber (Singh and Ahlawat, 6). In view of these fruits the present study was therefore undertaken to know the effect of N, P and Zn application on growth and yields performance of *ber*.

The experiment was conducted at CAZRI, Krishi Vigyan Kendra Farm, Pali during 2004-05 and 2005-06 on 15-year-old uniform and vigorous plants of cv. Gola. The treatments consisted three levels each of nitrogen, *i.e.* 250 g (N_1), 500 g (N_2) and 750 g (N_3) phosphorus, *i.e.* 200 g (P_1), 350 g (P_2) and 500 g (P_3) and zinc sulphate, *i.e.* 0.4% (Z_1), 0.6% (Z_2) and 0.8% (Z_3) comprising twenty eight treatment combination with one control. The experiment was laid out in RBD using factorial approach with three replication. Half dose of nitrogen and full dose of phosphorus were applied in July and remaining quantity of nitrogen at the time of fruit setting in month of November as a basal dose. Zinc sulphate was sprayed on plant foliage along with lime for neutralization and Teepol as a sticking agent in the 1st week of August, September and October.

The observation on growth parameters were recorded on randomly selected four shoots on each side of the tree. At the time of harvesting, shoot length, shoot girth, number of leaves per shoot and leaf area, number of fruits per tree were recorded. Five pickings were done and total yield was recorded accordingly. A random sample of 500 g fruits at colour turning stage was collected from 2nd picking from each replication and parameters like fruit length, fruit diameter, fruit weight and fruit volume were recorded. All the recommended cultural practices were adopted uniformly. The two years data were pooled and statistically analyzed according to the method suggested by Gomez and Gomez (2).

Nitrogen, phosphorus and zinc sulphate application to ber plants showed beneficial effect on plant growth as well as fruit yield. Perusal of data presented in Table 1 indicated that the shoot length, shoot girth, number of leaves/shoot, leaf area and number of fruits/tree increased with the application of nitrogen. Significantly maximum shoot length, shoot girth, number of leaves/ shoot and leaf area were revealed due to application of 750 g nitrogen/tree which was found at par with 500 g nitrogen. The number of fruits/tree was recorded with the application of 500 g nitrogen/tree. 3.64% increases was there for the number of fruits/tree over lowest dose of nitrogen (250 g nitrogen/tree). The phosphorus also significantly influenced the plant growth in *ber*. The shoot length, shoot girth, number of leaves/ shoot and leaf area increased with increasing levels of phosphorus from 200 to 500 g phosphorus/ tree. The foliar application of zinc sulphate greatly influenced vegetative growth of *ber* plants. The shoot length, number of leaves/ shoot and leaf area were increased significantly due to foliar application of 0.8% zinc sulphate which was found at par with 0.6% zinc sulphate. The maximum shoot girth was recorded with

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Table 1. Effect of N, P and Zn on growth and fruit yield of *ber*.

Treatment	Shoot length (cm)	Shoot girth (cm)	Number of leaves /shoot	Leaf area (cm^2)	Number of fruits/tree
Control	182.67	6.18	466	31.86	1608
N_1	224.09	7.90	742	37.22	1730
N_2	241.60	8.30	854	38.67	1793
N_3	243.92	8.49	891	39.14	1769
CD at 5%	6.45	0.29	51	0.70	43
P_1	230.94	7.93	773	37.71	1750
P_2	235.20	8.23	833	38.31	1776
P_3	243.47	8.53	879	39.01	1768
CD at 5%	6.45	0.29	51	0.70	NS
Z_1	227.91	7.94	781	37.47	1763
Z_2	239.69	8.49	833	38.66	1750
Z_3	242.01	8.25	872	38.90	1780
CD at 5%	6.45	0.29	51	0.70	NS

Table 2. Effect of N, P and Zn on yield and yield attributes in *ber*.

Treatment	Fruit length (cm)	Fruit dia. (cm)	Fruit weight (g)	Fruit volume (ml)	Yield (kg/tree)
Control	2.76	2.85	16.71	16.28	26.81
N_1	3.00	3.06	19.96	19.15	34.48
N_2	3.13	3.19	21.21	20.41	37.82
N_3	3.10	3.16	21.30	20.45	37.62
CD at 5%	0.03	0.03	0.55	0.50	0.76
P_1	3.04	3.11	20.27	19.49	35.41
P_2	3.06	3.13	20.65	19.86	36.46
P_3	3.13	3.16	21.55	20.67	38.05
CD at 5%	0.03	0.03	0.55	0.50	0.76
Z_1	3.04	3.10	20.24	19.51	35.63
Z_2	3.12	3.18	21.45	20.55	37.42
Z_3	3.07	3.12	20.79	19.95	36.88
CD at 5%	0.03	0.03	0.55	0.50	0.76

the application of 0.6% zinc sulphate. The minimum shoot length, shoot girth, number of leaves/shoot, leaf area and number of fruits/tree were recorded under control plot. Nitrogen, phosphorus being the major and zinc is minor essential nutrient for plant growth and development increased the efficiency of metabolic and physiological processes of plants and thus encouraged the vegetative growth and development of tree as compared to control. Similar findings were reported by Lal *et al.* (4), and Prasad (5).

The data pertaining to yield and yield attributes of fruit as influenced by the application of different levels of N, P and $ZnSO_4$ in ber have been presented in Table 2. Maximum fruit length, fruit diameter, and yield of fruits were recorded with application of 500 g nitrogen/ tree while fruit weight and fruit volume was recorded with the application of 750 g nitrogen/tree which was found at par with 500 g nitrogen/tree.

Application of different levels of phosphorus also significantly influenced the fruit length, fruit diameter, fruit weight, fruit volume and yield of fruits. Application of 500 g phosphorus /tree increased the fruit length, fruit diameter, fruit weight, fruit volume and yield of fruits. Foliar application of zinc sulphate also influenced fruit length, fruit diameter, fruit weight, fruit volume and yield of fruits. Maximum fruit length, fruit diameter, fruit weight, fruit volume and yield of fruits were recorded due to foliar application of 0.6% $ZnSO_4$, whereas minimum values were found under control. Zinc is essential component of enzymes responsible for

assimilation of nitrogen and phosphorus, help in chlorophyll formation and play important role in nitrogen and phosphorus metabolism, synthesis of growth regulating substances, oxidation and metabolic activity, which also increase the yield ultimately. These results are in the close agreement of the findings of Singh and Ahlawat (6), and Singh and Vashishtha (7).

The interaction effect of NxPxZ influenced the yield and diameter of fruit significantly. However, shoot length, shoot girth, number of leaves/ shoot, leaf area, weight of fruit, volume of fruit and number of fruits/ tree were not affected significantly by the interaction

Table 3. Effect of N, P and Zn internations on yield and fruit attributes of *ber*.

Treatment	Length (cm)	Diameter (cm)	Weight (g)	Volume (ml)	Yield (kg/tree)
control $N_1P_1Z_1$	2.762.94	2.852.98	16.7118.87	16.2818.15	26.8131.97
$N_1P_1Z_2$	3.02	3.06	19.45	18.66	33.63
$N_1P_1Z_3$	2.96	2.94	19.21	18.43	34.29
$N_1P_2Z_1$	2.97	3.06	19.78	19.06	32.73
$N_1P_2Z_2$	3.03	3.09	20.01	19.52	35.97
$N_1P_2Z_3$	2.98	3.03	20.19	19.23	34.73
$N_1P_3Z_1$	2.96	3.12	20.40	19.81	34.94
$N_1P_3Z_2$	3.11	3.08	21.01	19.90	36.01
$N_1P_3Z_3$	3.02	3.16	20.73	19.63	36.03
$N_2P_1Z_1$	3.08	3.13	19.87	19.22	35.57
$N_2P_1Z_2$	3.11	3.20	21.08	20.28	36.55
$N_2P_1Z_3$	3.04	3.11	20.12	19.56	36.28
$N_2P_2Z_1$	3.10	3.19	20.28	19.65	36.64
$N_2P_2Z_2$	3.10	3.18	21.48	20.60	36.92
$N_2P_2Z_3$	3.14	3.20	21.12	20.12	37.83
$N_2P_3Z_1$	3.14	3.18	21.66	20.90	39.15
$N_2P_3Z_2$	3.30	3.32	23.14	22.04	42.12
$N_2P_3Z_3$	3.16	3.22	22.13	21.34	39.32
$N_3P_1Z_1$	3.00	3.19	20.87	19.97	37.68
$N_3P_1Z_2$	3.12	3.23	21.95	20.88	37.20
$N_3P_1Z_3$	3.09	3.18	21.01	20.24	35.53
$N_3P_2Z_1$	3.04	3.17	19.45	18.80	35.78
$N_3P_2Z_2$	3.12	3.21	22.67	21.59	39.55
$N_3P_2Z_3$	3.04	3.05	20.92	20.15	38.02
$N_3P_3Z_1$	3.16	2.91	20.94	20.07	36.20
$N_3P_3Z_2$	3.15	3.26	22.28	21.45	38.80
$N_3P_3Z_3$	3.20	3.21	21.68	20.88	39.87
CD at 5%	NS	0.10	NS	NS	2.28

effects. The maximum yield of fruit (42.12 kg/tree) and diameter of fruit (3.22 cm) were recorded at $N_2P_3Z_2$ (500 g N + 500 g P_2O_5 + 0.6% $ZnSO_4$/ tree respectively) treatment combination as compared to the minimum (26.81 kg and 2.85 cm respectively) under control (Table 3). This is in close agreement with the results of Kumar and Tung (3), and Chaudhary and Singh (1).

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