

Studies on the response of integrated nutrient management on growth and yield of *ber*

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ABSTRACT

Studies were conducted to determine the effect of organic and inorganic sources of NPK and foliar spray of chemicals on plant growth, fruit yield and quality of *ber* cv. Gola. Different graded levels of FYM (37.5, 75 and 150 kg/plant) and Vermicompost (11, 22 and 45 kg/plant) were supplemented with different doses of inorganic fertilizers and foliar spray of chemicals (control, borax 0.4 per cent and thiourea 0.5 per cent) to balance fertilizer requirement of *ber* under semi-arid region of northern India. Experimental results revealed that application of 22 kg vermicompost + 0.82 kg urea + 1.15 kg SSP + 0.41 kg MOP per tree (F₅) and foliar spray of thiourea @ 0.5 per cent (T₂) significantly increased the plant height, plant spread, leaf area, average weight of fruit and fruit yield per tree and reduced the fruit drop. The ascorbic acid and iron content of fruits and NPK uptake by fruits were enhanced alongwith improvement in relative leaf water content (RLWC) and chlorophyll content in leaves under treatment F₅ and T₂. All these parameters were appeared to be dose and source dependent and best results were achieved with the combined application of 22 kg vermicompost + 0.82 kg urea + 1.15 kg SSP + 0.41 kg MOP per tree + foliar spray of thiourea @ 0.5 per cent under integrated nutrient management systems of *ber* orchard.

Key words: Integrated nutrient management, *ber*, growth, yield.

INTRODUCTION

Ber (*Zizyphus mauritiana* Lamk.), the poor man's fruit, is a cheap and rich source of ascorbic acid, vitamin 'A' as well as good source of thiamine, riboflavin, total soluble solids, protein, fat, carbohydrates, phosphorus, iron and calcium. There is an urgent need for nutritional package under semi-arid climatic and alkaline soil conditions to attain long term sustainability for quality fruit production as well as for maintaining soil productivity under integrated nutrient management system. Vermicompost has been advocated as good source of organic manures for use in integrated management practices of fruit crops. The integration of chemical fertilizers with organic manures has been found to be quite promising not only in maintaining higher productivity but also in providing greater stability in crop production (Singh *et al.*, 8). Foliar application of thiourea has also been reported beneficial in *ber* grown in arid regions (Yadav and Rathore, 10). Accordingly an investigation was undertaken to observe the effect of organic and inorganic sources of NPK and foliar application of chemicals (borax and thiourea) on plant growth, yield and fruit quality of *ber* cv. Gola under Rajasthan conditions.

MATERIALS AND METHODS

A field experiment was conducted during 2006-07 and 2007-08 at Horticulture Farm of the S.K.N. College

of Agriculture (S.K. Rajasthan Agricultural University), Jobner on twenty-year-old trees of *ber* cv. Gola. Seven levels of organic and inorganic sources of NPK and three levels of foliar application of chemicals were employed in the tree of *ber* having uniform growth and vigour. The treatments consisted of (A) inorganic and organic sources of NPK : F₀ = 1.65 kg urea, 3.91 kg SSP and 0.67 kg MOP (control), F₁ = 1.24 kg urea, 3.32 kg SSP and 0.35 kg MOP + 37.5 kg FYM, F₂ = 0.82 kg urea, 2.73 kg SSP and 0.04 kg MOP + 75 kg FYM, F₃ = 150 kg FYM, F₄ = 1.24 kg urea, 2.53 kg SSP and 0.54 kg MOP + 11 kg vermicompost, F₅ = 0.82 kg urea, 1.15 kg SSP and 0.41 kg MOP + 22 kg vermicompost and F₆ = 45 kg vermicompost; (B) Chemicals sprays: T₀ = Water (control), T₁ = borax 0.4% and T₂ = thiourea 0.5%.

The experiment was laid out in randomized block design with three replications. The full dose of FYM and vermicompost were applied in June and full dose of SSP, MOP and half dose of urea in July and remaining half dose of urea in October. Among chemicals, borax and thiourea were applied as foliar spray thrice in September (flower bud differentiation - FBD) and 20 and 40 days after first spray. Only water was used for spray in control treatment. The observation on plant height, plant spread, leaf area, average fruit weight, fruit drop, fruit yield, ascorbic acid and iron content in fruits; NPK uptake by fruits; total chlorophyll and

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relative leaf water content in leaves and organic carbon and water retention at 1500 and 33 kPa in soil were estimated following the standard methods as described by Ranganna (4), and Baruah and Barthakur (1).

RESULTS AND DISCUSSION

It is evident from the data presented in Table 1 that treatment F₅ increased plant height, plant spread, leaf area, average fruit weight and fruit yield per plant and reduced fruit drop as compared to treatment F₀, F₃ and F₆, where either inorganic or organic sources applied alone. However, the treatment F₅ was found statistically at par to F₂. The significant improvement in plant growth, yield attributes and yield on account of vermicompost application along with inorganic sources of NPK might have attributed due to the translocation of nutrients from soil and enhanced supply of macro and micro-nutrients during entire growing seasons and microbial decomposition (Singh and Ram, 7). Among chemicals, application of thiourea (T₂) was found significantly superior with respect to plant height, plant spread, leaf area, average weight of fruit and yield and reduced fruit drop (Table 1). The favourable effect of thiourea on plant growth and yield might be due to its bio-regulatory effect chiefly through mobilization of dry matter and translocation of photosynthates to sink. The favourable effect of thiourea on yield attributes and yield of *ber* was reported by Sankaran *et al.* (6).

Interactive effect of inorganic and organic sources of NPK and foliar application of chemicals (F_xT) was found significant for per cent fruit drop and fruit yield per

plant. The maximum fruit yield per tree and minimum per cent fruit drop were observed under treatment F₅T₂ (Table 2). The positive effect of combined application of inorganic and organic sources of NPK and thiourea on these parameters might be due to good availability and uptake of NPK in experimental field and balanced nutrition of crop with good photosynthesis. The results are also in close conformity with the findings of Uday *et al.* (9).

The results obtained in present investigation (Table 3) reveal that application of 22 kg vermicompost + 0.82 kg urea + 1.15 kg SSP + 0.41 kg MOP per tree (F₅) was found to be best treatment as compared to others with respect to fruit quality parameters like ascorbic acid and iron content and uptake of NPK by fruits. Although, treatment F₅ statistically at par to F₂. The potential role of organic and inorganic fertilization on nutritional aspects of fruits can be ascribed due to its direct effect on availability of vital nutrients and indirectly *via* release of growth hormones, vitamins and augmenting microbial population etc. during the process of organic decomposition. Further, beneficial effect of organic manure on improving soil physical properties in terms of better root penetration might have also helped in increasing biomass and NPK uptake as observed by Kaminwar and Rajagopal (3). The results obtained in study are also in close conformity with that of Ranjan and Ghosh (5) in *aonla*. Significantly higher ascorbic acid, iron content in fruits and NPK uptake by fruits were also reported with thiourea application (Table 3). The probable reason might be that thiourea

Table 1. Effect of inorganic and organic sources of NPK and foliar application of chemicals on growth and yield attributes of *ber*.

Treatment	Gain in plant height (cm)	Plant spread (m ²)	Leaf area (cm ²)	Fruit drop (%)	Av. fruit wt. (g)	Fruit yield (kg tree ⁻¹)
NPK source						
F ₀	139	27.19	52.79	60.41	09.54	41.34
F ₁	200	28.82	66.71	58.18	11.09	54.85
F ₂	231	30.32	72.58	52.56	11.74	62.30
F ₃	142	27.10	53.59	60.58	9.68	44.94
F ₄	242	31.33	75.75	53.58	11.96	58.95
F ₅	249	32.23	78.04	50.62	12.68	63.95
F ₆	158	28.17	64.05	59.18	10.49	52.37
CD (p = 0.05)	18	1.52	4.32	2.36	1.01	3.06
Chemical						
T ₀	169	27.95	62.32	62.93	10.37	48.42
T ₁	196	29.12	64.62	52.94	11.01	53.69
T ₂	218	30.86	71.70	53.45	11.69	60.19
CD (p = 0.05)	12	0.99	2.83	1.54	0.66	2.00

Table 2. Interactive effect of inorganic and organic sources of NPK and foliar application of chemicals on fruit drop and yield of *ber*.

Fruit drop (%)	F ₀	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆
T ₀	67.82	65.52	58.52	69.83	56.64	54.75	67.42
T ₁	57.15	53.82	48.58	55.14	52.09	47.57	56.22
T ₂	56.25	55.19	50.57	56.76	52.00	49.52	53.90
CD (p = 0.05)	4.08						
Fruit yield (kg tree ⁻¹)							
T ₀	36.66	47.84	52.33	43.64	55.49	54.71	48.23
T ₁	40.55	53.14	62.57	44.76	57.65	62.15	54.99
T ₂	46.80	63.55	71.99	46.41	63.70	74.97	53.89
CD (p = 0.05)	5.29						

Table 3. Effect of inorganic and organic sources of NPK and foliar application of chemicals on chemical composition of *ber*.

Treatment	Ascorbic acid (mg 100 ⁻¹ g pulp)	Iron content (ppm)	Nitrogen uptake (kg ha ⁻¹)	Phosphorus uptake (kg ha ⁻¹)	Potassium uptake (kg ha ⁻¹)
NPK source					
F ₀	70.04	0.256	179	69	100
F ₁	79.18	0.274	251	97	187
F ₂	90.90	0.295	304	119	233
F ₃	72.25	0.260	196	76	122
F ₄	82.13	0.322	277	107	217
F ₅	94.75	0.338	318	127	255
F ₆	75.14	0.347	237	89	153
CD (p = 0.05)	5.31	0.022	25	6	17
Chemical					
T ₀	72.35	0.273	219	88	159
T ₁	80.38	0.296	233	93	174
T ₂	89.15	0.327	303	111	209
CD (p = 0.05)	3.47	0.014	17	4	11

is a sulphhydryl compound and stimulates dark reaction of CO₂. The sulphhydryl is a dominant chemical group which plays bio-regulatory role in the plants due the presence of -SH group. Moreover, the -SH group has diverse biological activities. Thus, it is fairly conceivable that foliar spray of thiourea might have improved the nutritional quality in fruits. The results of the present finding supported with those previously reported by Yadav and Rathore (10). It is inferred from Table 4 that the application of FYM (F₃) and vermicompost (F₆) alone and/ or with a set of inorganic fertilizers (F₂ and F₅) gave significantly higher build up of organic carbon and water retention at 1500 and 33 kPa of soil and relative leaf water content of leaves during

experimentation. Although, higher total chlorophyll content in leaves was registered with treatment F₅ over application of inorganic fertilizers alone (F₀) but the foliar application of chemicals did not affect these parameters significantly (Table 4). The addition of manures itself adds sufficient amount of organic matter to the soil and solubilize plant nutrients and improve physical conditions of the soil by accelerating porosity, aeration and water holding capacity. It is also well documented fact that incorporation of organic manures with inorganic fertilizers in the soil not only acts as store house of macro- and micro-nutrients but also favourably affected physical and chemical characteristics of soil and plant (Bhriuvanshi, 2).

Table 4. Effect of inorganic and organic sources of NPK and foliar application of chemicals on physico-chemical properties of soil and plant in *ber*.

Treatment	Organic carbon (%)	Water retention at 1500 kPa (%)	Water retention at 33 kPa (%)	Relative leaf water content (%)	Total chlorophyll (mg g ⁻¹)
NPK source					
F ₀	0.209	3.77	11.92	59.50	4.77
F ₁	0.387	5.94	12.86	62.88	5.02
F ₂	0.403	6.42	13.95	67.10	5.44
F ₃	0.406	6.58	14.20	68.64	4.80
F ₄	0.373	5.61	12.63	63.21	5.31
F ₅	0.384	6.18	13.61	65.55	5.56
F ₆	0.392	6.25	13.85	66.55	4.92
CD (p = 0.05)	0.033	0.51	0.86	3.35	0.38
Chemical					
T ₀	0.365	5.68	12.95	61.19	4.79
T ₁	0.367	5.84	13.22	65.77	5.09
T ₂	0.361	5.93	13.54	67.36	5.47
CD (p = 0.05)	NS	NS	NS	2.19	0.25

Based on the above results, it application of 0.825 kg urea + 1.150 kg SSP + 0.410 kg MOP + 22 kg vermicompost (F₅) and foliar spray of thiourea @ 0.5 per cent (T₂) registered significantly higher plant growth, fruit yield and quality attributes in *ber*. A minimum fruit drop and significantly higher fruit yield were recorded with the application of 0.825 kg urea + 1.150 kg SSP + 0.410 kg MOP + 22 kg vermicompost along with foliar spray of 0.5 per cent thiourea.

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