INDIAN JOURNAL OF
ARID HORTICULTURE
2016, Vol. 11 (1-2):91-95

Comparative effect of organic manures and inorganic fertilizers on vegetative growth, yield and quality of Ber (*Zizyphus mauritiana* Lamk.) cv. Gola under Semi-arid conditions

Rajbala Choudhary , O. P. Garhwal, M R Choudhary , Hari Dayal Choudhary and Manoj Kumar Rolanis
Department of Horticulture, S.K.N. College of Agriculture
S.K.N. Agriculture University, Jobner, Jaipur
(Received: 13.10.2016; Accepted: 22.02.2017)

Abstract

An experiment was carried out at S.K.N.A.U.,Jobner (Jaipur) Rajasthan to find out the comparative effect of organic manures and inorganic fertilizers on growth parameters of three years old ber orchard cv. Gola. Four levels of organic manures (control, FYM @ 20 kg/plant, Vermi- compost @ 6 kg/plant and poultry manure @ 8 kg/plant) and five levels of RDF (control, 50% RDF, 75% RDF, 100% RDF and 125% RDF) in Randomized Block Design with three replications were taken to provide balance fertilization of ber under semi-arid region of northern India during 2015-16. The experimental results revealed that application of Vermi-compost @ 6 kg/plant and 125% recommended dose of fertilizers significantly influence the growth parameters (Plant height, plant spread (E-W and N-S), number of primary branches, average length of primary branch, number of secondary branches per primary branch and leaf area), fruit yield (kg/plant and q/ha) and fruit quality (TSS and acidity content) of experimental plants

Key words: Organic manures, inorganic fertilizers, semi-arid conditions, vegetative growth, fruit yield and quality.

Introduction

Indian jujube (*Zizyphus mauritiana* Lamk.) is an important fruit crop of hot arid ecosystem due to less water requirement, wider adaptability, hardy nature and its ability to flourish well even in poor quality soil. So it is known as "King of Arid Fruits". It belongs to the family Rhamnaceae which has about 50 genera and more than 600 species (Pareek, 1983). In India, ber is being cultivated on an area of about 4845 hectares with production of 66,296 metric tonnes (Anonymous, 2014). Madhya Pradesh, Bihar, Punjab, Haryana, Gujarat and Rajasthan are the major ber growing states. Among the different cultivars of ber, Gola is an extremely drought hardy, early & extensively grown variety. The fruits are round in shape & skin is golden yellow when ripe. The TSS content of pulp is 16.0-20.0 per cent, vitamin 'C' content ranges from 70-130 mg/100g, acidity varies from 0.14-0.25 per cent and average yield is about 80 kg per tree.

The Indian jujube is grown chiefly for its fruits which may be eaten fresh, dried or canned, smoked and pickled or used in drinks. Several products like ber butter, ber squash or juice, ber murabba, ber pulp, ber jam and dehydrated or dried products may also be made of ber fruits (Pareek, 1983 and Yamdgni, 1985). Various Ayurvedic and Yunani medicines contain ber extract which is said to be blood purifier and also help in digestion. Ber tree is important host plant for insect *Laccifer lacca* (Kerr.) which secrets a resinous substance on the twigs which is the raw materials for shellac preparation.

It has a remarkable adaptability enabling it to grow in a wide range of agro-climatic situations and soils (Rana *et al*., 1979). It is well documented that growth and yield of trees are greatly influenced by a wide range of nutrients. The cultivation of this crop in arid and semi-arid regions is mainly done but, due to one or another reason farmers are not harnessing the desired production potential of the crop. The potent reasons for lesser productivity could be attributed to poor management. Ber produces fruits continuously for a long time, thus it needs proper and integrated nutrients to have regular feeding at vegetative as well as reproductive phase of the tree. The intensively cultivated soils do have the problems of fast depletion of plant nutrients and become deficient not only in macro but also in micro nutrients (Singh *et al*., 1998). An approach involving chemical fertilizers and organic manures to bridge this gap between nutrient demand and supply for giving a boost to crop production is only the solution. The situation further aggravates for the light soil of Rajasthan, where

nutrient use remains much lesser than the removal (Gupta, 2001).

Keeping the above facts into consideration, an investigation on organic and inorganic sources of nutrients in Ber (*Zizyphus mauritiana* Lamk.) was carried out to identify the comparative effect of different sources of nutrients with respect to vegetative growth, fruit yield and quality of ber plants.

Materials and Methods

An experiment was conducted at Horticulture farm, S.K.N. college of Agriculture, Jobner (Jaipur) during July, 2015 to February, 2016 in the orchard of Ber cv. Gola under loamy sand soils. The plants of uniform size, vigorous and three years age after budding spaced at 6 m x 6 m were selected. It consisted of 20 treatment combinations with four levels of organic manures (M_0-control, M_1-FYM @ 20 kg/plant, M_2-vermicompost @ 6 kg/plant and M_3-poultry manure @ 8 kg/plant) and five levels of RDF (F_0-control, F_1-50% RDF, F_2-75% RDF, F_3-100% RDF and F_4-125% RDF) in Randomized Block Design with three replications.

The full dose of organic manures was applied as soil application in July, 2015. The recommended doses of fertilizers 1100 g urea, 1400 g SSP and 200 g MoP per tree were applied. Full dose of SSP, MoP and half dose of urea in various treatments were applied as basal dose in July, 2015. Remaining half dose of urea was applied before flowering. The fertilizers were applied to the top soil around the plant. The fertilizers uniformly mixed into the soil and then levelled. Irrigation was applied immediately after application of manures and fertilizers. The role of nutrient elements either alone or in combination with other sources (organic manures/fertilizers) has been well established in many fruit crops; while such studies are very meagrely available in ber (Katiyar *et al.*, 2012).

Growth attributes in terms of plant height (cm), trunk girth (cm), plant spread (E-W and N-S in cm)), average length of primary branch (cm) and number of secondary branches per primary branch of experimental plants were recorded twice in a year, before application of treatments in the month of July, 2015 and at full bloom stage in the month of October, 2015 and gain in these parameters were calculated with the help of thread and meter scale. The number of primary branches per plant and average leaf area using Leaf Area Meter, LICOR-3000 Lincoln, USA and expressed as cm^2 was measured at full bloom stage in the month of October, 2015.

Ripened fruits were harvested and the weight was recorded by summing up the total of fruits at different pickings obtained during January 8, 2016 to February 25, 2016 from each experimental plant. Quality components *viz.,* total soluble solids (^{0}Brix) with the help of Zeiss^{Tm} hand refractometer and acidity content (A.O.A.C., 1980) of ripe fruits were also analyzed.

Statistical analysis

To test the significance of variation in the data obtained from various growth, yield and quality characters, the technique of statistical analysis of variance was suggested by Fisher (1950) for Randomized Block Design. Significance of difference in the treatment effect was tested through 'F' tests at 5 per cent level of significance and CD (critical difference) was calculated, wherever the results were significant.

Results and Discussion

Vegetative growth

Perusal of data regarding to plant height, plant spread (E-W and N-S), number of primary branches, average length of primary branch, number of secondary branches per primary branch and average leaf area of experimental plant presented in table-1 significantly affected by application of various organic manures and fertility levels.

The maximum gain in plant height (77.15 cm), gain in plant spread in E-W direction (111.85 cm) and N-S direction (109.58 cm), number of primary branches (22.00), gain in average length of primary branch (91.25 cm), number of secondary branches (8.51) and average leaf area (29.12 cm^2) were observed in treatment M_2 (Vermi-compost @ 6 kg/plant) which is significantly superior than rest of the treatments except M_3 (Poultry manure @ 8 kg/plant). The data presented in table 1 indicates that application of different organic manures and fertility levels brought about non-perceptible variation to gain in trunk girth. All the above vegetative growth parameters of experimental plants were recorded significantly poor under control.

As Vermi-compost is a slow releasing organic manure which contains most of the macro as well as micro nutrients in chelated form and fulfill the nutrient requirement of plant for longer period. Vermi-compost helps in reducing C:N ratio, increased humic acid content, cation exchange capacity and water soluble carbohydrates (Talashilkar *et al.*, 1999). The improvement in plant height by the application of organic manures like vermin-compost might be due to better moisture retention capacity, supply of micronutrients and easy availability of major nutrients of soil (Reddy *et al.* 1998). Improvement in soil parameters might have helped in increasing the absorption of nutrients from soil, enhanced carbohydrate assimilation and production of new tissues, which ultimately increased vegetative growth.

A further reference to data showed in table-1indicated that application of 125% RDF recorded maximum gain in plant height (78.75 cm), gain in plant spread in E-W direction (118.51 cm) and N-S direction (115.17 cm), number of primary branches (22.15), gain in

average length of primary branch (97.28 cm), number of secondary branches (8.62) and average leaf area (28.83cm^2) which was significantly higher as compared to control, 50% RDF and 75% RDF but found statistically at par with treatment F_3 (100% RDF. The better growth and development of plant under this treatment might be due to better nutritional environment in root zone as well as in plant system.

Nitrogen, phosphorus and potash are most indispensable among all mineral nutrients for growth and development of plant as it is basis of fundamental constituents of all living matter present. The biological role of NPK as an essential constituent of chlorophyll and nucleic acid, in harvesting solar energy, energy transformation from phosphorylated compound, transfer of genetic information, regulation of cellular metabolism and structural unit compound is well known. All these are found abundantly in the growing and storage organ, promote healthy root, shoot and full development (Devlin and Witham, 1986). The findings are in agreement with the reports of Lal and Dhaka (2003), Prasad (2005) and Devashi (2012).

Table 1. Effect of organic manures and fertility levels on vegetative growth parameters of Ber cv. Gola

Treatments	Plant height (cm)	Trunk girth (cm)	Plant spread in E-W direction (cm)	Plant Spread in N-S direction (cm)	Number of primary branches (cm)	Average length of primary branch (cm)	Number of secondary branches (cm)	Average leaf area (cm^2)
Organic Manures								
M_0	66.12	2.55	88.64	86.92	18.55	69.20	4.65	23.23
M_1	72.04	2.65	101.54	98.20	20.01	80.40	6.71	26.12
M_2	77.15	2.76	111.85	109.58	22.00	91.25	8.51	29.12
M_3	75.30	2.71	110.36	107.31	21.22	89.28	8.35	28.11
SEm±	1.29	0.07	2.25	2.92	0.36	2.02	0.14	0.58
CD (P=0.05)	3.69	NS	6.43	8.37	1.02	5.78	0.40	1.66
Fertility Levels								
F_0	63.14	2.52	77.95	75.09	17.84	56.69	4.33	23.42
F_1	69.79	2.62	94.66	92.35	19.43	75.71	6.20	25.56
F_2	74.36	2.70	108.48	105.22	20.81	87.63	7.60	26.76
F_3	77.22	2.74	115.89	114.68	21.99	95.36	8.52	28.65
F_4	78.75	2.75	118.51	115.17	22.15	97.28	8.62	28.83
SEm±	1.44	0.08	2.51	3.27	0.40	2.26	0.15	0.65
CD (P=0.05)	4.16	NS	7.25	9.44	1.15	6.52	0.45	1.87

Fruit yield

The data pertaining to the effect of organic manures and fertility levels (NPK) *viz.,* fruit yield (kg/plant) and fruit yield (q/ha) of ber are summarized in table-2. Yield is a complex character which depends on yield contributing characters. Application of organic manures significantly affected the fruit yield per plant as well as per hectare.The maximum Fruit yield (15.31 kg/plant and 42.56 q/ha) under treatment M_2 (Vermi-compost @ 6 kg/plant) was observed which was significantly higher as compared to control and M_1 (FYM @ 20 kg/plant. But it was statistically at par with treatment M_3 (Poultry manure @ 8 kg/plant).

The significant improvement in fruit yield on account of vermin-compost application was largely a function of improved growth *i.e*. multiplication & cell elongation, tissue differentiation and therefore consequent increase in yield attributes and yield (Singh and Meena, 2004). The increase in yield with application of vermin-compost may also be ascribed to sustained availability of balanced nutrient throughout the growing period and which resulted increased vegetative growth. The narrow C:N ratio might also helped in increased nutrient uptake and synthesis of carbohydrates which ultimately enhanced yield.

Similarly, application of various fertility levels (NPK) had also significantly influenced the fruit yield. The maximum fruit yield (15.11 kg/plant and 42.02q/ha)) was found under treatment F_4 (125% RDF) which was statistically at par with F_3 (100% RDF). The application of inorganic fertilizers might have also increased the availability of nutrients directly which in turned increased fruit yield. The findings of present investigation are in agreement with those of Prasad (2005), Dalal *et al.* (2011), Dayal *et al.* (2011), Dhomane and Kadam (2013).

Fruit quality

The data regarding to total soluble solids and acidity contents in fruits mentioned in table-2 revealed that application of different organic manures and fertility levels (NPK) gave significant results. The maximum total soluble solids (19.55^{0}Brix) and minimum acidity (0.397%) were

observed in treatment M_2 (Vermi-compost @ 6 kg/plant) which was significantly higher to rest of the treatments except M_3 (Poulttry manure @ 8 kg/plant). The increase in TSS content and decrease in acidity content in fruits might be clear to better availability of desired and required quantity of nutrients for longer period in root zones of plant resulting from its solubilization of organic matter and chelation of available nutrients.

The TSS and acidity content in fruits also affected significantly by application of various fertility levels (NPK). The application of treatment F_4 (125% RDF) recorded maximum TSS (20.19^{0}Brix) and minimum acidity (0.367%) in fruits which was found statistically at par with F_3 (100% RDF) but significantly higher to other treatments. Arora *et al.* (2012) reported that potassium is a major nutrient element essential for translocation of sugar and increase TSS content in fruits. The increase in TSS content and decrease in acidity content in ber fruits may also be due to increased activity of nitrate reductase enzyme and enhanced synthesis of certain amino acid and proteins. Similar results were also obtained by Bhatia *et al.* (2001), Mahalle *et al.* (2001) and Kundu *et al.* (2011).

Table 2. Effect of organic manures and fertility levels on fruit yield and quality of ber cv. Gola

Treatments	Fruit yield (kg/plant)	Fruit yield (q/ha)	TSS (^{0}Brix)	Acidity (%)
Organic Manures				
M_0	8.03	22.32	17.35	0.448
M_1	12.00	33.36	18.38	0.421
M_2	15.31	42.56	19.55	0.397
M_3	14.59	40.56	19.31	0.414
SEm±	0.26	0.70	0.29	0.007
CD (P=0.05)	0.73	2.01	0.82	0.020
Fertility Levels				
F_0	7.61	21.16	16.33	0.483
F_1	11.01	30.60	17.87	0.449
F_2	13.82	38.41	18.96	0.418
F_3	14.86	41.31	19.90	0.383
F_4	15.11	42.02	20.19	0.367
SEm±	0.29	0.78	0.32	0.008
CD (P=0.05)	0.83	2.26	0.93	0.023

References

A.O.A.C. 1980. Official Methods of Analysis. 13th Ed. *Association of Official Analytical Chemists*, Washington, D.C.

Anonymous, 2014. Indian Horticulture Database-2014, National Horticulture Board, Gurgaon.

Arora, N.K., Gill, M.I.S. and Navjot, 2012. Influence of nitrogen, phosphorus and potassium fertilizers on yield and quality of grapes cv. Perlette. *Hort Flora Research Spectrum*, 1(1): 17-23.

Bhatia, S.K., Ahlawat, V.P., Gupta, A.K. and Rana, G.S. 2001. Physico-chemical attributes of guava as affected by nitrogen application. *Haryana Journal of Horticultural Sciences*, 30: 65-66.

Dalal, R.P.S., Navjot, Thakur, A. and Brar, J.S. 2011. Effect of foliar application of nutrients on leaf mineral composition and yield of ber (*Zizyphus mauritiana* L.) under arid conditions. *Annals of Arid Zone,* 50(1): 53-56.

Dayal, H., Meghwal, P.H., Singh, D. and Lal, G. 2011. Response of ber to nutrient management in relation to yield and physic-chemical composition of fruits under semi-arid condition. *Annals of Arid Zone*, 50(1): 63-66.

Devashi, V. 2012. Effects of organic and inorganic nitrogen on growth, yield and quality of Sapota 'Kalipatti'. *Journal of Fruit and Ornamental Plant Research,* 20(1): 55–64.

Devilin, R.M. and Witham, F.H. 1986. Plant Physiology. C.B.S. Publishing and Distributor, Delhi.

Dhomane, P.A. and Kadam, A.S. 2013. Influence of different sources of nitrogen on yield and benefit cost ratio of guava (*Psidium guajava* L.) cv. 'Sardar'. *Scholarly Journal of Agricultural Science*, 3(7): 261-63.

Fisher, R.A. 1950. Statistical Methods for Research Worker. Oliver and Boyd. Edinburgh.

Gupta, A.K. 2001. Nutrient mixing in agro-climatic zones of Rajasthan. *Fertilizer News,* 46(9): 39-46.

Katiyar, P.N., Tripathi, V.K., Sachan, R.K., Singh, J.P. and Ram Chandra, 2012. Integrated nutritional management affects the growth, flowering and fruiting of rejuvenated ber. *Hort Flora Research Spectrum*, 1(1): 38-41.

Kundu, S., Datta, P., Mishra, J., Rashmi, K. and Ghosh, B. 2011. Influence of bioferilizer and inorganic fertilizer in pruned mango orchard cv. Amrapali. *Journal of crop and weed*, 7(2): 100-103.

Lal, G. and Dhaka, R.S. 2003. Effect of phosphorus and potassium fertilization on growth and yield of *ber* (*Zizyphus mauritiana* L.) cv. Umran. *Hamdard Medicus*, 46(4): 80-81.

Mahalle, P.H., Jadhav, B.J., Panchai, D.M. and Athawale, R.B. 2001. Effect of N, P and K on growth, fruit set, yield and quality of custard apple. *Orissa Journal of Horticulture,* 29(2): 54-57.

Pareek, O.P. 1983. The jujube, Indian Council of Agricultural Research, New Delhi. pp. 71.

Prasad, R.N. 2005. Effect of N and P on growth, yield and quality of ber grown under rainfed conditions of Indian arid zone. *Indian Journal of Horticulture*, 62(4): 404-06.

Rana, R.S., Ahuja, P.S. and Singh, K.N. 1979. The Ber in salt affected areas. *Indian Farming*, 29(5): 5-7.

Reddy, R., Reddy, M.A.N., Reddy, Y.T.N., Reddy, N.S. and Anjanappa, 1998. Effect of organic and inorganic sources of NPK on growth and yield of pea (*Pisum sativum*). *Legume Research*, 21: 57-60.

Singh, A. and Meena, N.L. 2004. Effect of nitrogen and sulphur on growth, yield attributes and seed yield of Mustard *(Brassica juncea*) in eastern plains of Rajasthan. *Indian Journal of Agronomy*, 49: 186-88.

Singh, O., Balyan, O.S. and Rana, M.K. 1998. Effect of INM on growth, yield and economics of okra (*Abelmoschus esculentus* L.) cv. Varsha Uphar. *Haryana Journal of Horticultural Sciences*, 26(3-4): 254-57.

Talashikar, S.C., Bhangarath, P.P. and Mehta, 1999. Changes in chemical properties during composting of organic residues as influenced by earthworm activity. *Journal of the Indian Society Soil Science*, 47(1): 50-53.

Yamdgni, R. 1985. Jujube in: Fruits of India Tropical and Sub-tropical. 1st ed. T.K.Bose (Edit.) Nayaprakash, Calcutta, pp. 250-536.