Soil Environ. 30(2): 166-170, 2011
www.se.org.pk
Online ISSN: 2075-1141
Print ISSN: 2074-9546

Short Communication
Fruit yield improvement of deteriorated guava plants in salt affected soil

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Abstract

Soil Salinity is a common problem throughout the world. However, it is seriously affecting the economy of Pakistan by limiting crop productivity on a large area of 6.68 m ha. Various salt tolerant crop / plant varieties are grown in salt affected soil. Guava (Psidium Guajava L.) is a salt tolerant fruit plant and is one of the most popular fruits in Pakistan. Guava has attained commercial importance in tropics and sub-tropics because of its adaptability to varied soil and climatic conditions. Most of the plants grown in salt affected soils lose their bearing after some time. The present study was conducted to improve the fruit bearing of guava plants grown through modified rhizosphere technique. For this purpose five years old guava plants growing in saline sodic field [pH_s, 8.8; EC_e, 4.70 dS m^{-1}; SAR, 32.30 (m mol $L^{-1})^{½}$ and GR, 7.56 t ha^{-1}] were selected. The treatments applied were: T_1 = control; T_2 =gypsum @ 100% GR; T_3 = gypsum @ 100% GR + FYM @ 40 kg $plant^{-1}$; T_4 = gypsum @ 100% GR + FYM @ 40 kg + urea @ 1.0 kg $plant^{-1}$; T_5 = gypsum @ 100% GR + FYM @ 40 kg + urea @ 1.5 kg $plant^{-1}$ and T_6 = gypsum @ 100% GR + FYM @ 40 kg + urea @ 2.0 kg $plant^{-1}$. All the gypsum, phosphorus, potash and half of the urea were applied in the month of February, and the remaining half of urea was applied in the month of August. Maximum fruit yield (28.13 kg $plant^{-1}$) was obtained with the application of treatment T_6 (gypsum @ 100% GR + FYM @ 40 kg + urea @ 2.0 kg $plant^{-1}$) followed by the treatment T_5 (gypsum 100% GR + FYM @ 40 kg + 1.5 kg urea $plant^{-1}$) giving fruit yield of 22.35 kg $plant^{-1}$ and least in control (4.29 kg $plant^{-1}$).

Keywords: Guava, fertilizer, fruit yields, salt affected soil,

Guava is successfully grown in Pakistan, India, Island and Brazil. It is greatly relished for its flavor, delicious taste and high nutrient value. In salt affected soils, the growth and yield of fruit plants like guava is affected due to problems associated with the development of salinity, nutritional imbalance and specific ion effect (Gratten and Grieve, 1999). Niazi *et al.* (2000) and Zaka *et. al.* (2008) reported that maximum decrease in SAR was observed when soil was treated with gypsum @ 100% GR. It also significantly increased fruit yield $plant^{-1}$, other parameters and also lowered the pH, EC_e and SAR of the soil up to safe limits during the study period. In Pakistan, farmers do not fertilize guava plants according to their requirement. Guava bears fruit two times in a year (autumn and winter) due to which, the most suitable time for fertilizer application is the months of February and August.

Researchers have investigated that increasing rates of N improved yield of different specices of fruit trees. Shukla *et al.* (2009) reported that application of 50% recommended dose of NPK + 50 kg FYM + 250g Azotobacter significantly produced higher fruit weight, ascorbic acid contents, total sugar contents and fruit yield of guava plants. Fruit yield of guava plant was recorded maximum with combined application of FYM and chemical fertilizer. Combined application of manure and chemical fertilizer to guava plant produced higher fruit yield, fruit size, single fruit weight and total soluble solids compared with fertilizer alone (Faqir *et al.,* 2000). It was also reported that the combination of organic manure/organic matter with inorganic N in the integrated plant nutrition system provides the ideal condition for crop which improves soil properties and fertilizer N supply to plants (FAO, 1998). Manures and fertilizer requirement of guava plant vary with varieties, age of plant, soil fertility and management practices. Although, inorganic fertilizers are commonly used to make up nutrient deficiency, yet combined application of organic and inorganic manures proved better than their individual application (Muhammad *et al.,* 2000). Nitrogen plays a major role in improving tree vigor, fruit bud formation and fruit setting. The deficiency of N results in small sized and inferior quality fruit due to reduction in normal and functional leaves surface (Khan *et al.*, 1983). Tandon (1998) suggested that the use of organic manure along with less quantity of chemical fertilizers resulted in higher crop yield than chemical fertilizer alone. It is an established fact that guava fruits are borne always on new branches. Shah *et al.* (2006) investigated that maximum pruning, produce more number of branches and nitrogen

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concentration obtained in treatment receiving 75% mineral N and 25% N from FYM. Although use of mineral fertilizer is the quickest way of increasing crop production. The organic manures, improve the soil physical and micro-biological conditions and thus enhance fertilizer use efficiency when applied in combination with mineral fertilizers (Lampe, 2000). Bashir *et al.* (2009) concluded that maximum fruit yield plant^{-1} (63.78 kg), single fruit weight (193.52 g) , fruit size (Length and diameter, 9.74 cm x 7.63 cm) , number of seeds (200.80 fruit^{-1}) and TSS (total soluble solids, 11.35%) were given by guava plants applied with 40 kg FYM +1.0 kg each of N , P_2O_5 and K_2O plant^{-1}. Aiyelaagbe (1989) reported that NPK in various combinations was applied to guava before initiation of new growth to increase number of fruit, fruit size and weight as compared to NPK applied separately. Ball (2005) studied that for obtaining higher fruit yield and better quality fruit, 50 kg FYM, half of inorganic fertilizer (1.0 kg urea, 2.5 kg phosphorus and 1.05 kg murate of potash) in May-June and remaining half in September should be applied. For sustainable production, application of nitrogen through urea (40%) and FYM (60%), increased fruit size and yield of guava when half N and full FYM were applied in June and remaining N in September (Yadav, 2007). Zia *et al.* (2006) also reported that application of fertilizer obtained from an appropriate nutrient source and appropriate growth stage gives good returns. Keeping in view, the importance of application of manure and fertilizer, this experiment was planned on fruit yield improvement of deteriorated plants in salt affected soil.

Most of the fruit plants grown in salt affected soils lose their bearing after few years. The present study was conducted to improve soil health through modified rhizosphere techniques. A barren field was selected, leveled and ridges were made 6m x 6m apart in the field. Holes of 90 x 90 cm were dug with post hole digger on the shoulder of ridges and filled with silt. Guava plants were planted in the center of the hole. After five years, the guava plants showed nutrition deficiency symptoms and dropping of flowers and fruits due to the accumulation of salt in the pits. The experiment was conducted at Soil Salinity Research Institute, Pindi Bhattian during 2007-08 to 2009-10 to see the effect of N (urea) with the combination of FYM and Gypsum on fruit yield, number of fruit plant^{-1} and size of fruit. The experimental field had pH_s, 8.8; EC_e, 4.70 dS m^{-1}; SAR, 32.30 (mmol L^{-1})$^{1/2}$ and GR, 7.56 t ha^{-1}. The guava orchard was selected where trees were planted with row to row and plant to plant distance of 6m. The study was carried out in randomized complete block design having four replications. Five years old, four Guava plant (Gola variety) of nearly uniform in size, growth, vigor and almost of same age were selected for each treatment. The treatments were as under.

Control (without gypsum and FYM)
Gypsum alone (100% GR)
Gypsum (100% GR)+ FYM (40 kg) plant^{-1}
Gypsum (100% GR) + FYM (40 kg) + 1.0 kg urea plant^{-1}
Gypsum (100% GR) + FYM (40 kg) + 1.5 kg urea plant^{-1}
Gypsum (100% GR) + FYM (40 kg) + 2.00 kg urea plant^{-1}

All the PK (Phosphorus and potassium sulphate, 500 g to each plant^{-1}) and ½N were applied in the form of TSP (Triple super phosphate), K_2O (potassium sulphate) and urea as basal dose in the month of February. The remaining ½ dose of urea was applied in the month of August. All other cultural practices were kept uniform. Data of fruit size, number of fruits plant^{-1}, single fruit weight and fruit yield plant^{-1} were recorded. Yield was expressed as the total number of fruit and weight of fruit produced plant^{-1} in each season that was harvested in July-August and December-January. The data were statistically analyzed using analysis of variance technique and treatment means were compared by employing least significant difference (LSD) test (Steel *et. al.*, 1997).

Increase in fruits yield of guava plant was observed with the application of Gypsum, FYM and different combination of organic and inorganic fertilizers over control in all the three seasons of study. It is clear from the data (Table 1) that maximum fruit yield (28.13 kg plant^{-1}) was obtained with treatment where Gypsum (100% GR) + FYM (40 kg) + urea (2.0 kg) plant^{-1} were applied followed by the treatment where Gypsum (100% GR) + FYM (40 kg) + urea (1.5 kg) plant^{-1} were used (22.35 kg plant^{-1}). Application of Gypsum (100% GR) and FYM (40 kg plant^{-1}) also proved better for improving fruit yield than control (4.29 kg plant^{-1}). It was also observed that treatments where the combined application of gypsum, FYM and urea were applied bore fruit for a longer time as compared to control and Gypsum alone. Immature fruit dropping was also noticed less in fertilized treatments than control. It might be due to more availability of major and minor nutrients with the application of FYM, Gypsum and NPK in salt affected soil resulting in fruit yield improvement as compared to alone application of Gypsum, FYM or control. It was also investigated that reclamation of soil improved /increased fruit yield of guava plant each year. The results are supported by Khan *et al.* (1983), Tandon (1998), Lampe (2000), Ball (2005), Shah *et al.* (2006), Yadav (2007) and Bashir *et al.* (2009).

The data of number of fruits plant^{-1} (Table 2) showed the influence of Gypsum, FYM and nitrogenous fertilizer rates on the yield of guava plants. Maximum number of

fruits plant^{-1} (291) were received from the treatment where combined application of Gypsum (100% GR) + FYM (40 kg) + urea (2.0 kg) plant^{-1} were used. However, minimum numbers of fruits plant $^{-1}$ (81) were recorded by control. The Increase in number of fruits plant $^{-1}$ was observed in each year of study. The significant effect of maximum fertilizers was observed on vegetative growth, number of fruits and less dropping of flowers and fruits. It might be due to cumulative effect of Gypsum, FYM and fertilizer. The results are in agreement with the findings of Khan *et al.* (1983), Aiyelaagbe (1989), Faqir *et al*. (2000) and Shukla *et al.* (2009).

Single fruit weight data (Table 3) showed significant effect of gypsum, FYM and different levels of urea on fruit weight. Fruit weight increased with the increasing level of urea levels. Maximum fruit weight (68.62 g) was recorded where gypsum + FYM and 2.0 kg urea plant^{-1} was applied followed by the treatment where Gypsum + FYM + 1.5 kg urea plant^{-1} were applied (61.18 g). However, the minimum fruit weight (20.81g) was received from the control. It might be due to combined application of organic and inorganic fertilizers with gypsum which provide the ideal conditions by improving the soil properties. The results are in line with Niazi *et al.* (2000), Faqir *et al*. (2000), Bashir *et al*. (2009) and Shukla *et al.* (2009).

Data showed (Table 4) that maximum size of fruit (74.62 cm^3) was gained with application of gypsum (100% GR) + FYM (40 kg) + urea (2.0 kg) plant^{-1}. The minimum fruit size was produced by the control treatment (39.35 cm^3). It is clear from the data that fruit size increased with increasing rates of urea. Although FYM and gypsum alone also proved better than control. It might be due to

Table 1: Guava fruit yield as affected by organic and inorganic fertilizer in salt affected soil

Treatment	Fruit yield kg plant^{-1}			Mean
Year	2007-08	2008-09	2009-10	
Control	2.37 E	4.04 F	5.38 E	4.29 F
Gypsum alone (100% GR)	5.83 D	6.37 E	7.77 D	6.93 E
Gypsum (100% GR)+ FYM (40 kg) plant^{-1}	7.76 D	9.51 D	11.64 D	10.14 D
Gypsum (100% GR)+ FYM (40 kg) + urea (1.0 kg) plant^{-1}	15.97 C	16.76 C	20.09 C	18.23 C
Gypsum (100% GR) + FYM (40 kg) + urea (1.5 kg) plant^{-1}	19.68 B	20.52 B	24.61 B	22.35 B
Gypsum (100% GR) + FYM (40 kg)+ urea (2.00 kg) plant^{-1}	23.85 A	25.43 A	31.62 A	28.13 A
LSD	**3.316**	**0.956**	**3.119**	**0.463**

Table 2: Number of fruits plant^{-1} as affected by organic and inorganic fertilizer in salt affected soil

Treatment	Number of fruits plant^{-1}			Mean
Year	2007-08	2008-09	2009-10	
Control	58 F	90 F	96 E	81 F
Gypsum alone (100% GR)	61 F	104 E	113 DE	93 E
Gypsum (100% GR)+ FYM (40 kg) plant^{-1}	104 D	116 D	121 D	114 D
Gypsum (100% GR)+ FYM (40 kg) + urea (1.0 kg) plant^{-1}	167 C	209 C	269 C	215 C
Gypsum(100% GR) + FYM (40 kg) + urea (1.5 kg) plant^{-1}	178 B	264 B	303 B	248 B
Gypsum (100% GR) + FYM (40 kg)+ urea (2.00 kg) plant^{-1}	189 A	322 A	362 A	291 A
LSD	**1.236**	**4.943**	**17.805**	**4.609**

Table 3: Single fruit weight as affected by organic and inorganic fertilizer in salt affected soil

Treatment	Single fruit weight (g)			Mean
Year	2007-08	2008-09	2009-10	
Control	20.27 F	21.00 E	21.17 F	20.81 E
Gypsum alone (100% GR)	36.15 E	39.89 D	40.34 E	38.79 D
Gypsum (100% GR)+ FYM (40 kg) plant^{-1}	38.37 D	40.82 D	42.81 D	40.67 D
Gypsum (100% GR)+ FYM (40 kg) + urea (1.0 kg) plant^{-1}	45.60 C	50.00 C	56.31 C	50.64 C
Gypsum (100% GR) + FYM (40 kg) + urea (1.5 kg) plant^{-1}	58.31 B	61.79 B	63.45 B	61.18 B
Gypsum (100% GR) + FYM (40 kg)+ urea (2.00 kg) plant^{-1}	65.00 A	67.60 A	71.90 A	68.62 A
LSD	**1.96**	**1.64**	**1.13**	**1.96**

reclamation of microsphere of the plant with the application of gypsum and more availability of nutrients with the application of organic and inorganic fertilizers to the plant at proper time. The results are in confirmatory with Faqir *et al*., (2000), Yadav (2007), Bashir *et al.* (2009) and Shukla *et al.* (2009).

The data (Table 5) showed that salinity/sodicity of the soil decreased after the harvest of fruit plants during all the three years. The maximum reduction in EC_e, pH_s and SAR of the soil was observed in the treatment where urea was applied in combination with FYM followed by gypsum application. The decrease in pH of the soil might be due to the exchange of Na^+ by Ca^{++} with the application of gypsum. Moreover, organic acids produced during the decomposition of FYM solubilized the applied gypsum which removed Na^+ from the exchangeable complex resulting in the lowering of soil pH. Similar results were reported by Patrick *et al. (*1985).

The decrease in EC_e of the soil might be due to the application of gypsum followed by flooding. With the application of gypsum, physical properties of the soil like infiltration rate and hydraulic conductivity were also improved and soluble salts leached down from the root zone followed by flooding. Similar results were reported by Sarwar (2005) and Zaka *et al.* (2008).

Conclusions

It was concluded from the study that the combined application of Gypsum, FYM (40 kg) and 2.0 kg urea plant^{-1} produced better fruit yield of guava plant in salt affected soil. It was also recorded that the salinity/sodicity levels gradually decreased with the application of gypsum and FYM up to safe limits during the study period.

References

Aiyelaagbe, A. 1989. Effect of fertilizer on the growth and yield of Guava. Technical Bulletin. *National*

Table 4: Size of fruit as affected by organic and inorganic fertilizer in salt affected soil

Treatment	Size of Fruit (cm^3)			Mean
Year	2007-08	2008-09	2009-10	
Control	38.19 E	38.09 F	41.30 D	39.35 E
Gypsum alone (100% GR)	40.52 D	41.75 E	42.83 C	41.73 E
Gypsum (100% GR)+ FYM (40 kg) plant^{-1}	41.41 D	41.95 D	43.00 C	42.75 D
Gypsum (100% GR)+ FYM (40 kg) + urea (1.0 kg) plant^{-1}	61.63 C	63.93 C	67.93 B	64.50 C
Gypsum (100% GR) + FYM (40 kg) + urea (1.5 kg) plant^{-1}	68.84 B	70.36 B	73.95 A	71.05 B
Gypsum (100% GR) + FYM (40 kg)+ urea (2.00 kg) plant^{-1}	71.51 A	73.79 A	76.78 A	74.02 A
LSD	**2.101**	**2.633**	**3.213**	**2.771**

Table 5: Soil status of guava orchard after picking each year

Treatment	2007-08			2008-09			2009-10		
	pH	EC_e (dS m^{-1})	SAR $(mmolL^{-1})^{1/2}$	pH	EC_e (dS m^{-1})	SAR $(mmol\ L^{-1})^{1/2}$	pH	EC_e (dS m^{-1})	SAR $(mmolL^{-1})^{1/2}$
Control	8.66 A	4.10 A	38.50 A	8.52 A	4.09 A	38.35 A	8.50 A	4.07 A	38.34 A
Gypsum alone (100% GR)	8.41 B	3.39 B	17.51 B	8.25 B	3.34 BC	14.58 B	8.21 B	3.31 BC	14.55 B
Gypsum+ FYM (40 kg) plant^{-1}	8.31 C	3.35 C	15.64 D	8.24 B	3.32 BCD	13.31 C	8.18 BC	3.30 C	13.29 C
Gypsum + FYM (40 kg) + 1.0 kg urea plant^{-1}	8.32 C	3.38 B	15.35 E	8.23 B	3.36 B	13.32 C	8.17 C	3.34 B	13.30 C
Gypsum + FYM (40 kg) + 1.5 kg urea plant^{-1}	8.31 C	3.34 CD	16.00 C	8.24 B	3.30 D	12.92 D	8.18 BC	3.28 CD	12.89 D
Gypsum + FYM (40 kg) + 2.00 kg urea plant^{-1}	8.31 C	3.32 D	15.61 D	8.23 B	3.28 D	12.17 E	8.18 BC	3.25 D	12.15 E
LSD	0.038	0.028	0.076	0.034	0.044	0.059	0.038	0.032	0.032

Horticulture Research Institute, Ibadan 11(1): 137-139.

Ball, J.S. 2005. Fruit Growing. Kalyani Publishers Ludhiana, India. p. 253-261.

Bashir, M.A, M. Ahmad, M.R. Salik and M.Z. Awan. 2009. Manure and fertilizer effect on yield and fruit quality of Guava. *Journal of Agricultural Research* 47(3): 247-51.

FAO. 1998. Guide to efficient plant nutrition management land and water development division FAO, Rome, Italy.

Faqir, M; M. A. Shakir and M. R. Salik. 2000. Effect of individual and combined application of organic and inorganic manures on the productivity of guava plants. *Pakistan Journal of Biological Sciences* 3(9): 1370-1371.

Gratten, S.R. and C.M. Grieve. 1999. Salinity/sodicity nutrient relation in horticultural crops. *Scientia Horticulturae* 78: 127-157.

Khan, H., S. Ali and S.A. Hussain. 1983. Fertilization of stone fruit orchards. Farmer Bulletin No. 7. Department of Agriculture, Agriculture Research Institute, Tarnab, Peshawer.

Lampe, S. 2000. Principal of integrated plant management system. p. 3-17. *In:* Proceeding symposium on integrated plant nutrient management. NFDC, P&D Division, Government of Pakistan, Islamabad.

Muhammad, F.M., A. Shakir and M.R. Salik. 2000. Effect of individual and combined application of organic and inorganic manures on the productivity of Guava. *Pakistan Journal of Biological Sciences* 3(9): 1370-1371.

Niazi, B.H., N. Hussain, M. Salim, G. Hassan and A. Ali. 2000. Effect of split application of gypsum on wheat yield and properties of saline-sodic soil irrigated with brackish water. *International Journal of Agriculture and Biology* 3: 234-236.

Patrick, W.H. Jr., D.S. Mikkelsen and B.R. Wells. 1985. Plant nutrient behavior in flooded soil. p. 197-228. *In*: fertilizer technology and use. OP. Engelstad (ed.), 3rd Ed. Soil Science Society of America Inc., Madison, WI, USA.

Sarwar, G. 2005. Use of compost for crop production in Pakistan. Ph.D. Thesis, University of Kassel, Germany.

Shah, S.M., W. Muhammad, S.A. Shah and H. Nawaz. 2006. Integrated nitrogen management of young deciduous apricot orchard. *Soil and Environment* 25(1): 59-63.

Shukla, A. K; D. K.Sarolia, B. Kumari, R. A. Kaushik, L. N. Mahawer and H.L. Bairwa. 2009. Evaluation of substrate dynamics for integrated nutrient management under high density planting of guava (cv. Sardar). *Indian Journal of Horticulture* 66(4): 461-464.

Steel, G.D., H.J. Torrie and D.A. Dickey. 1997. Principles and procedures of statistics. A Biometrical Approach, 3rd Ed. Mc Graw Hill Book International Company, Newyork. 400-428p.

Tandon, H.L.S. 1998. Organic fertilizer. A source book Fertilizer Development and Consultation Organization, New Delhi.

Yadav, P.K. 2007. Fruit production Technology. International Book Distribution Company Lucknow, Uttar Paradesh, India. p. 223-240

Zaka, M.A., H.U. Rafa, S.M. Mehdi and O.U. Rehman. 2008. Amelioration of saline sodic soil by flushing and leaching. *Soil and Environment* 27: 171-176.

Zia, M.H., R. Ahmad, I. Khaliq, A. Ahmad and M. Arshad. 2006. Micronutrients status and management in orchard: Applied aspects. *Soil and Environment* 25: 6-16.