

Full length Research paper

Integrated Application of NPK Fertilizers on the Growth and Yield of Guava (*Psidium Guajava* L.) in Arid Region of Lower Sindh, Pakistan

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An experiment was conducted to study the fruit yield and growth rate of guava with the application of different rates of NPK fertilizers along with constant doses of Gypsum and FYM at a private farmhouse located at south-east of Gharo, Sindh – Pakistan during year 2012-13. The fruit yield in terms of plant height (3.08 m), length of fruit (6.92 cm), breadth of fruit (6.01 cm), weight of fruit (110.45gm), number of fruits per plant (375.92), was recorded maximum in plants which were treated with T₉. Same treatment also showed the superior fruit quality traits evaluated in terms of TSS (9.28%), Vitamin C (44.70 mg per 100 ml of juice), and Firmness (5.91 kg/cm²) with lower acidity (0.48 %).

Keywords: Guava, NPK Fertilizer, Agriculture, Gharo, Sindh, Pakistan.

INTRODUCTION

Guava (*Psidium Guajava* L.) is a very popular fruit mostly used as a dessert fruit for its delicious taste and nutritive values. In Pakistan it comes at number three after Citrus and Mango fruits. It is approximately cultivated on large scale in all four provinces of Pakistan. The average per acre yield of Guava in Pakistan is 25 – 30 tons per acre which is very low as compared to other countries. It can easily grow on the clayey, loam, sandy loam and sandy soils having pH 4.5 – 8.5. It can also grow on water logged and saline soils as it can tolerate salinity and alkalinity upto some extent. Safeda, Chittidar, Hafsi, Karayla, Seedless, Allahabad, and Apple Guava are some common grown varieties in Hyderabad, Larkana, Khairpur, Multan, Sargodha, Gujranwala, Lahore, Shiekhupura, Faisalabad, Kohat, Hazara, Dera Ismaiel Khan and Banu. Guava is propagated both by seeds and vegetatively. However, in Pakistan Guava is mostly grown through seeds which nowadays should not be encouraged because the seedlings have long juvenile phase, give lower yields and bear low quality fruits FFC (2015). Therefore, researchers and scientists are working on tissue culture for the promotion of good quality Guava in the state.

The planting is distributed from February to March or August to September. A spacing 6 - 8m in either way is generally followed. The field for planting is prepared by ploughing, leveling and removing weeds. The pits of 1m x 1m x 1m size are dug and filled with a mixture of farmyard manure and soil. Irrigation is especially desirable after planting for survival of the plants and thereafter for 2-3 year to obtain early good growth. Irrigation of fruiting plants depends upon the adoption of a particular cropping pattern. Young plants require water throughout the year depending upon the climatic and land conditions. However, water requirements are more in plants when fruits are developing on the trees Singh et al., (2007). Inorganic fertilizers should be applied according to the soil testing results.

Traditionally fertilizers are applied in split doses in two stages throughout the year (i) before winter fruiting and (ii) after harvesting. Pruning takes place only for the weakest branches of the plant. Guava plants are attacked by wilt due to various fungi, which alone causes heavy losses. It is very difficult to find out an orchard of guava more than 30 years in age because most of its plants die at about 20 years of age due to wilt. Therefore, the planti

-ng material should not be obtained from a wilt infected region or nursery. The main plague to affect guava is fruit fly. Guava fruits develop best flavor and aroma only when they ripen on tree. In most of the commercial varieties, the stage of fruit ripeness is indicated by the color development which is usually yellow.

For local market, fully yellow but firm fruits are harvested, whereas half yellow is picked for distant markets TNAU (2015). The fruits are harvested selectively by hand along with the stalk and leaves. The potential motive of the subject research work is to evaluate the Guava (*Psidium Guajava* L.) response in the wake of application of various rates of NPK fertilizers through flood irrigation technique and to measure the quantitative and qualitative parameters of Guava under agro-ecological saline region of Gharo, Sindh – Pakistan.

MATERIALS AND METHODS

Location and Size of the Study Area

The study was undertaken in the month of October, 2012 at a private farmhouse located at south-east of Gharo, Sindh – Pakistan. This farm is located 65 KM away from Karachi on National Highway (Karachi - Hyderabad). The model farm comprises of 6 acres approx., from which 5 acres was cultivated with different fruit trees and the remaining portion of the farm was kept fallow.

Background and Topographic Conditions of the Study Area

The subject farm was facing a serious problem of water scarcity and salinity as there was no canal water available the only source for irrigation was groundwater. During initial survey it had been observed that the topographic condition of the farmhouse is varying due to uneven slopes. The soil condition was moderately saline and due to less water retention in the soil, uneven slopes, and poor land leveling some plants are suffering very much. A lot of extra grass and weeds were grown throughout the land. And due to nutrients deficiency in the soil and plants Guava fruits are either dropping or giving small size fruits. The age of plants was 3-4 years but the height of the plants was found small. The water samples had been collected for the conductance of different water tests. Likewise, the samples of the soil were collected from three different zones at 6 inch and 12 inch depth for different laboratory tests purposes on composite basis. The results of the soil and water samples are given in (Table 1-2) respectively.

On the basis of results obtained it had been decided by the experts and owner that in order increase the yield of

Guava fruits a small scale research study should to be process for long term high yield. Therefore, in order to get maximum yield for from existing guava plants a pilot study was started in the month of December 2012.

Field experiment

An experiment was laid out in 2012-13 in Randomized Block Design with nine treatments and three replications at a private farmhouse located at south-east of Gharo, Sindh – Pakistan. In order to achieve precise results initially weed and extra grass removal operation on the existing guava plots had been started. Tractor with cultivator implement had been used for the weed and extra grass removal operation. The average depth of cultivator was about 1 – 1.5 ft and the weeds and extra grass removal work had been completed in total 4 operations on each patches. After the completion of operation the grass and weeds left on the land for natural sun drying. Two days later the weeds and extra grass were fully sun dried and had been cleaned (hand-picked) manually by labor. After the cleaning operation land was leveled by a tractor with rear blade throughout the guava patches and divided into small sub-plots. After the completion of land leveling, water channeling operation had been done by the help of tractor with channel maker implement and basins of plants has been made manually by local labor accordingly.

At this point the land preparation work has been completed. The existing guava plants (Allahabad variety) were transplanted at a spacing of 6m x 8m during February 2009 on an area of 2 acres. With the objective to achieve more fruit yields from saline land, 40 kg FYM + 3 kg Gypsum was provided to each existing plant accordingly. Mixture of gypsum - FYM was applied one week before the application of NPK fertilizers. The treatments used are T₁ (control – no fertilizer), T₂ (500:500:500g NPK/plant), T₃ (600: 600: 600g NPK/plant), T₄ (650: 650: 650g NPK/plant), T₅ (700:700:700g NPK/plant), T₆ (750:750:750g NPK/plant), T₇ (800:800:800g NPK/plant), T₈ (900:900:900g NPK/plant) and T₉ (1000:1000:1000g NPK/plants).

The treatments provided to the plants in two split phases i.e. half dose after last harvest and half before the fruiting of upcoming guava yield in September. Fertilizer applied between the radial distances 200 to 260 cm away from trunk, 15-25 cm deep and then properly covered with soil. For recording the fruit quality observations five mature fruits were randomly selected from each observational plant and same fruits were used for recording the various physico-chemical properties of guava. (Figures a-f) describes the overall farming operations during the research study of the model farm for guava-(orchard).

Table 1 Analysis Results of Soil (at 6 and 12 inch depth on composite basis)

S No.	Parameters	Test Results	
		Sample 01 (06 inch depth)	Sample 02 (12 inch depth)
1	pH at 25° C	8.07	9.84
2	EC	1.8175 ds/m	0.192 ds/m
3	Nitrogen	107.76 kg/ha	83.3 kg/ha
4	Phosphorus	54.234 kg/ha	30.75 kg/ha
5	Potassium	983.25 kg/ha	355.5 kg/ha
6	SAR	1.41	0.422

Table 2 Analysis Results of Water

S No.	Parameters	Test Results
1	pH at 25° C	7.55
2	EC	3.85 ds/m
3	SAR	7.97
4	CaCO ₃ Hardness	852.90 mg/l
5	HCO ₃	300.17 mg/l
6	TDS	2636.00 mg/lit

**Figure 1a:** Weeds Removal**Figure 1b:** Rough Levelling with Rear Blade**Figure 1c:** Water Channeling Operation**Figure 1d:** Water Channeling Operation



Figure 1e: Before Weed Removal Process



Figure 1f: After Weed Removal Process

RESULTS AND DISCUSSION

The subject research was carried out to check the fruit yield and growth rate of guava in a saline land conditions with the application of different rates of NPK fertilizers along with constant doses of Gypsum and Farmyard manure to all plants under study. The subject study revealed that guava plant height, length of fruit, breadth of fruit, weight of fruit, number of fruits per plant, fruit yield, TSS%, Acidity, Vitamin C, and Firmness differed very significantly between application of different rates of NPK fertilizers as mentioned in (Table 3). The critical gathered observations and data for the above discussed parameters during the subject research are appended below:

Plant Height

Statistically remarkable results were observed for plant height with maximum 3.08 m and minimum 2.74 m in T_9 and T_1 respectively. The detailed results for all fertilizers rates are given in Table III. Nearly same results were achieved by treatments T_7 and T_8 . The study clearly implies that the increment in fertigation rate in addition of 3 kg gypsum and 40 kg FYM directly increases the plant height which means that they are directly proportional to each other. The present finding is in agreement with the findings of Khan et al., (2013), in guava.

Length of fruit

NPK Fertilizers rates with 3 kg gypsum and 40 kg FYM had a very positive effect on length of fruit for saline soils as shown in Table III. From the obtained results it is clear that length of fruit increased with the increase in NPK fertilizers treatment rates. The length of fruit was maximum 6.92 cm for T_9 and minimum 6.21 cm for T_1 respectively. However, near about same results for maximum fruit length was achieved by T_7 and T_8

treatments. The present finding is in agreement with Kaur et al. (2002) in guava.

Breadth of fruit

Statistically considerable results were observed for breadth of fruit as shown in Table III.

Maximum 6.01 cm and minimum 5.17 cm for breadth of fruit were recorded in T_9 and T_1 treatments respectively. Once again for the breadth of fruit same observation was noted with COV 6.39 %.

The discussed findings are in accordance with José et al. (2007) in guava.

Number of fruits per plant

During the research study it had been observed that maximum number of fruit 375.92 was noted in T_9 , while minimum 293.04 fruits per plant was observed in T_1 (control).

The detailed results for all fertilizers rates are given in Table: III.

Once again for the number of fruits per plant same observations were noted with COV 29.19 % and SE + 9.89 respectively.

The present finding is in agreement with Sharma et al (2011) for guava.

Weight of fruit

The application of proper plants nutrients can boost up the growth of guava plant which eventually increases the weight of fruits per plant accordingly.

According to the obtained results it had been observed that maximum 110.45 gm weight per fruit were recorded in T_9 and minimum 79.89 gm weight per fruit were recorded in control T_1 .

The similar findings were also reported by Chandra et al., (2001) in guava.

Table 3 Effect of different rates of NPK fertilizers on fruit quantity and fruit quality parameters of guava.

Treatment	Plant Height	Length of Fruit	Breadth of Fruit	Weight of Fruit	Number of fruits per plant	Fruit yield	Fruit Quality Parameters			
							TSS	Acidity	Vitamin C	Firmness
	M	cm	cm	Gm		kg / plant	%	%	(mg per 100 ml of juice)	kg /cm ²
T ₁	2.74	6.21	5.17	79.89	293.04	23.41	8.99	0.58	24.83	3.77
T ₂	2.75	6.27	5.36	85.76	311.92	26.75	9.22	0.54	28.56	4.72
T ₃	2.78	6.33	5.56	87.36	323.03	28.22	9.38	0.51	29.95	4.47
T ₄	2.83	6.40	5.63	89.70	331.53	29.74	9.15	0.49	27.32	4.97
T ₅	2.88	6.40	5.68	89.81	335.60	30.14	9.28	0.56	34.76	4.10
T ₆	2.96	6.40	5.68	92.10	333.43	30.71	9.44	0.47	37.25	4.70
T ₇	3.04	6.53	5.75	99.96	332.23	33.21	9.48	0.49	43.46	4.91
T ₈	3.06	6.53	5.88	106.86	347.57	37.14	9.24	0.56	24.83	4.69
T ₉	3.08	6.92	6.01	110.45	375.92	41.52	9.28	0.48	44.70	5.91
SE(m)+	0.17	0.25	0.21	10.77	9.89	4.30	0.36	0.49	4.60	2.10
LSD (p<0.05)	NS**	NS**	NS	NS	NS	NS	NS	NS	NS	NS
COV(%)	9.72	6.64	6.39	12.81	29.19	12.70	6.59	20.23	24.13	33.42

Means followed by different letter shows significant result at 5% level of significance.

Fruit yield

On the basis of conducted study and statistical analysis of all harvesting operations it had been observed that application of different rates of NPK fertilizers with application of 3 kg gypsum and 40 kg FYM, had a positive effect on the yield kg / plant with COV 12.70% and SE + 4.30 accordingly.

Maximum yield was found to be 41.52 kg / plant when fertilized with treatment T₉.

Likewise the minimum production was recorded in control 23.41kg per plant for treatment T₁.

The similar findings were also reported by Ramniwas et al (2012) for guava.

Fruit Quality Parameters

The chemical fruit quality in terms of maximum total soluble solids 9.63%, minimum acidity 0.48%, Vitamin C (44.70 mg per 100 ml of juice) and firmness 5.91 kg/cm² were recorded with treatment T₉ whereas, lowest total soluble solids 8.99%, maximum acidity 0.58%, Vitamin C (24.83 mg per 100 ml of juice) and firmness 3.77 kg/cm² were recorded in treatment T₁ control.

These results are in accordance in with Sharma et al. (2009) in Guava.

CONCLUSIONS

The outcome of the conducted research in arid region of Gharo, Sindh – Pakistan during year 2012-13 tantamount

that the NPK fertilizers application along with constant doses of Gypsum and FYM brought a positive effect in guava cultivation. Amongst different treatments rates of NPK, 1000 grams (T₉) was observed to be more suitable and economical

dose as the fruit yield in terms of plant height (3.08 m), length of fruit (6.92 cm), breadth of fruit (6.01 cm), weight of fruit (110.45gm), number of fruits per plant (375.92), was recorded maximum.

Same treatment also showed the superior fruit quality traits evaluated in terms of TSS (9.28%), Vitamin C (44.70 mg per 100 ml of juice), and Firmness (5.91 kg/cm²) with lower acidity (0.48 %).

Nearly same results were achieved by T₈ and T₇ treatments but statistical some parameters recorded less. However, control plants showed un-satisfactory results regarding all the parameters.

Too low or high NPK levels reduced the yield and yield parameters of guava.

Although with supplementation of constant gypsum and FYM doses the salinity significantly reduced up to some extent and helps in more yield per plant.

By adopting such activity the yield per acre in saline soils can be increased. Therefore, there is a need for further researches to differentiate differences among the combination of different doses of gypsum and FYM.

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