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Full length Research paper

Impact of integrated application of NPK fertilizers on growth and yield of Sapota (Achras sapota L.) under agro-ecological zone of Gharo

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A pragmatic study was contrived to ascertain the effect of different rates of NPK fertilizers on the growth and yield of Sapota during the year 2012-13 at a private farmhouse located at south-east of Gharo, Sindh – Pakistan. The fruit yield per plant (kg/plant) was found maximum in those plants which are treated with T_7. For the same treatment number of fruit (1506.557), length of fruit (4.186 cm), breadth of fruit (5.050 cm), volume of fruit (112.512 cc), weight of fruit (120.835 gm), pulp weight (97.594 gm), peel weight (22.080 gm) and yield per plant (189.629 kg/plant) was recorded maximum. Same treatment also showed the superior fruit quality traits evaluated in terms of maximum total soluble solids and total sugar was (22.234 ^oB) and (17.309%) with minimum acidity of (0.048%). However, control plants showed un-satisfactory results regarding all the parameters. Amongst the various NPK treatments T_7 was observed to be more suitable and economical dose therefore, application of fertilizers beyond this level will be an uneconomical and wasteful practice.

Keywords: Sapota, NPK fertilizer, Agriculture, Gharo, Sindh, Pakistan.

INTRODUCTION

The Sapota (Achras sapota L.) fruit contains high degree of nutrients which makes it delicious and due to which it serves as a dessert. In Pakistan, the mature fruits are also used for making jams as these provide a valuable source of raw material for the manufacture of industrial glucose, pectin and natural fruit jellies. They are also canned as slices. It is approximately cultivated on large scale in all provinces of Pakistan. 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. In the tropics, some cultivars bear almost continuously. The main season is from December to March (FFC, 2015). The trees bear from May to September with the peak of the crop in June and July. 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. Inorganic fertilizers should be applied according to the soil testing results (TNAU, 2015).

It is very productive fruit as compared to other fruits. Nature has enhanced this fruit to bear the biotic and antibiotic stresses. If proper care and fertilizers are provided it yield entails in huge volume due to the best quality fruit weight etc (Sharma et al., 2009). Traditionally fertilizers are applied in split doses in two stages throughout the year (i) before winter fruiting and (ii) after harvesting. It is to reminded that regular use of chemical fertilizers entails in eroding soil health which is very

dangerous due to which chemical and physical properties of soil are adversely affected which further end up in low down of yield as well (Singh at al., 2007). Pruning takes place only for the weakest branches of the plant. The fruits mature in four to six months after flowering (Chandra et al., 2001). The potential motive of the subject research work is to evaluate the sapota response in the wake of application of various rates of NPK fertilizers and to measure the quantitative and qualitative parameters of Sapota under agro-ecological 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 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.

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 sapota 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. 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 sapota 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 sapota plants were transplanted at a spacing of 6m x 8m during February 2009 on an area of 3 acres. The various fertilizer treatments used are T_1 (control – no fertilizer), T_2 (200g:125g:50g NPK/plant), T_3 (400g:250g:100g NPK/plant), T_4 (600g:375g:150g NPK/plant), T_5 (800g:500g:200g NPK/plant), T_6 (1000g:625g:250g NPK/plant), T_7 (1200g:750g:300g NPK/plant), T_8 (1350g:875g:400g NPK/plant) and T_9 (1500g:1000g:500g 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 sapota yield in September. Fertilizer applied within the radial distances 200 to 260 cm apart from trunk, depth was kept 15-25 cm and covered properly with soil. Five mature Sapota fruits were randomly selected from each observational plant and their physico-chemical properties were analyzed accordingly. The data was recorded for Number of Fruits per plant, Fruit Yield (kg/Plant), Fruit Weight (gm), Length of fruit (cm), Breadth of fruit (cm), Fruit Volume (cc), Pulp weight / fruit (gm), Peel weight / fruit (gm), TSS (^oB), Total Sugar (%), and Acidity (%). Finally the data analysis and statistical analysis were done through ANOVA procedure.

RESULTS AND DISCUSSION

The subject research was carried out to check the fruit yield and growth rate of sapota with the application of different rates of NPK fertilizers in Gharo agro-ecological conditions. The subject study revealed that sapota Number of Fruits per plant, Fruit Yield (kg/Plant), Fruit Weight (gm), Length of fruit (cm), Breadth of fruit (cm), Fruit Volume (cc), Pulp weight / fruit (gm), Peel weight / fruit (gm), TSS (^oB), Total Sugar (%), and Acidity (%) differed very significantly between application of different rates of NPK fertilizers as mentioned in Table: I and (Table 2). The critical gathered observations and data for the above discussed parameters during the subject research are appended below:

Number of fruits per plant

During the research study it had been observed that maximum number of fruit (1506.557) was noted in treatment T_7, while minimum 1138.560 fruits per plant was observed in T_1 (control). It is perceived that control condition and excessive use of nutrient might have exercised negative impact on the quality and quantity parameter of the crop with SE$\pm$ (9.792) and CD at 5% (28.886). The present finding is in agreement with (Baviskar et al., 2011) for sapota.

Length of fruit

Various rates of NPK Fertilizers had a very positive effect on length of fruit (Table 1). 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 (4.186 cm) for T_7 and minimum (3.168 cm) for T_1 respectively. However, near about same results for

Table 1. Effect of various NPK treatments on number of fruits per plant, fruit yield, fruit weight, length & breadth of fruit, fruit volume, pulp weight / fruit, peel weight / fruit.

Treatments	No. Of fruits per plant	Length Of Fruit	Breadth Of Fruit	Volume Of Fruit	Weight Of Fruit	Pulp Weight Per Fruit	Peel Weight Per Fruit	Fruit Yield
		(cm)	(cm)	(cc)	(gm)	(gm)	(gm)	(kg/Plant)
T1	1138.560	3.168	3.197	43.200	58.877	45.600	10.205	71.030
T2	1197.754	3.648	4.070	78.144	84.893	68.256	15.101	105.888
T3	1212.154	3.610	4.282	70.560	86.592	68.640	16.608	109.373
T4	1220.160	3.677	3.869	60.096	74.064	57.600	14.237	94.157
T5	1256.640	3.581	3.955	63.744	75.888	60.096	14.496	99.264
T6	1300.800	3.552	4.186	87.552	95.990	76.320	17.472	130.147
T7	1506.557	4.186	5.050	112.512	120.835	97.594	22.080	189.629
T8	1503.360	3.869	4.762	95.616	107.549	84.000	21.600	168.509
T9	1452.154	4.128	4.906	104.256	117.456	94.714	21.437	177.792
F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	9.792	0.125	0.202	3.130	2.227	3.370	0.864	4.253
CD at 5%	28.886	0.365	0.595	9.235	6.586	9.936	2.554	12.566

maximum fruit length was achieved by T_8 and T_9 treatments. The present finding is in agreement with (Dalal et al., 2004) in sapota.

Breadth of fruit

Statistically considerable results were observed for breadth of fruit as shown in Table I. Maximum (5.050 cm) and minimum (3.197 cm) for breadth of fruit were recorded in T_7 and T_1 treatments respectively. Once again for the breadth of fruit same observation was noted with SE± (0.202) and CD at 5% (0.595). The discussed findings are in accordance with (Manjunatha et al., 2006) in sapota.

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

According to the obtained results it had been observed that maximum (120.835 gm) weight per fruit were recorded in T_7 and minimum (58.877 gm) weight per fruit were recorded in control T_1. The similar findings were also reported by (Baviskar et al., 2011) for sapota.

Pulp and Peel Weight per Fruit

It was also observed in the subject experiment that pulp weight and peel weight per fruit has showed upward trend.

Maximum pulp weight (97.594 gm) and peel weight (22.080 gm) was gained by using treatment T_7 following

Volume of Fruit

Statistically remarkable results were observed for volume of fruit with maximum (112.512 cc) and minimum (43.200 cc) in T_7 and T_1 treatments respectively.

The detailed results for all fertilizers rates are given in (Table 1). Nearly same results were achieved by treatments T_8 and T_9.

The study clearly implies that the increment in fertigation rate directly increases the volume of fruit which means that they are directly proportional to each other upto some extent.

The present finding is in agreement with the findings of (Khan et al., 2013), in guava.

Weight of fruit

T_8 and T_9. Whereas, minimum pulp weight (45.600 gm) and peel weight (10.205 gm) were obtained by using no fertilizer (control treatment).

From the results it is clear that increase in pulp weight and peel weight might have been increased due to increase in fertilizer dosage (Table 1). The findings are in conformity of (Hiwale et al., 2010) in sapota.

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 had a good effect on the fruit yield kg / plant with SE± (4.253) and CD at 5% (12.566) accordingly.

Maximum yield (189.629 kg/plant) was found when plants were fertilized with treatment T_7 followed by T_8 and T_9

Table 2. Effect of various NPK treatments on Fruit Quality Parameters.

Treatments	TSS	Total Sugar	Acidity
	^{o}B	(%)	(%)
T1	15.418	15.130	0.060
T2	19.200	16.656	0.054
T3	20.602	16.867	0.054
T4	19.133	16.138	0.054
T5	19.104	15.648	0.052
T6	20.410	15.629	0.053
T7	22.234	17.309	0.048
T8	20.986	17.146	0.050
T9	20.765	17.011	0.050
F' Test	Sig.	Sig.	Sig.
SE(m)±	0.624	0.058	0.001
CD at 5%	1.862	0.173	0.003

treatments. Likewise, the minimum production was recorded in control (71.030 kg/ plant) for treatment T_1. The similar findings were also reported by (Patel et al., 2010) for sapota.

Fruit Quality Parameters

The chemical properties of the fruit were also boosted after the use of various treatments of NPK fertilizers as maximum total soluble solids and total sugar was (22.234 ^{o}B) and (17.309%) with minimum acidity of (0.048%) with the use of T_7 treatment.

Whereas, when T_1 (control) was applied minimum chemical properties with maximum acidity was found. These results are in accordance in with (Baviskar et al., 2011) for sapota.

CONCLUSIONS

The outcome of the conducted research in the agro-ecological region of Gharo, Sindh – Pakistan during year 2012-13 tantamount that the application of various rates of NPK fertilizers brought a positive effect in Sapota cultivation.

It is a fact that application of inorganic fertilizers might have played an important role in controlling absorption and translocation of diverse metabolic systems by increasing the ratio of carbohydrates which affects the quality of fruits.

Amongst different treatments rates of NPK fertilizers, T_7 was observed to be more suitable and economical dose as the fruit yield in terms of number of fruit (1506.557), length of fruit (4.186 cm), breadth of fruit (5.050 cm), volume of fruit (112.512 cc), weight of fruit (120.835 gm), pulp weight (97.594 gm), peel weight (22.080 gm) and yield per plant (189.629 kg/plant) was recorded maximum.

Same treatment also showed the superior fruit quality traits evaluated in terms of maximum total soluble solids and total sugar was (22.234 ^{o}B) and (17.309%) with minimum acidity of (0.048%). Nearly same results were achieved by T_8 and T_9 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 Sapota.

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