JOURNAL OF AGRICULTURE AND CROP SCIENCE
Journal homepage: www.jakraya.com/journal/jacs

ORIGINAL ARTICLE

Nutrient Removal Studies in Guava under High Density Orcharding System

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Received: 25/10/2014

Revised: 04/11/2014

Accepted: 05/11/2014

Abstract

Under traditional planting system of guava, nutrient management practices have been standardized. However, high-density orcharding of guava is gaining momentum owing to more profit per unit area. It is therefore imperative to asses' nutrient requirement under high density planting system. Such recommendations should be based on nutrient removal studies under different densities. Keeping these points in view, present study was undertaken and it was observed that there was significant effect of plant densities on nitrogen removal during winter cropping with maximum uptake (75.15 kg/ha) in T5 (278 pls/ha). The highest phosphorus removal (18.30 kg/ha) was recorded during rainy season under T1 (833 pls/ha). During winter cropping significantly higher amount of potassium (71.93 kg/ha) was removed through fruits in T5 (278 pls/ha). About 2-2.5 times more quantity of nutrients were removed during rainy season. Thus for getting sustainable yield year after year it is necessary to replenish these nutrients in form of manure and fertilizers.

Keywords: Guava, High density planting, Nutrient removal, yield.

1. Introduction

The increasing importance of guava (*Psidium guajava* L) as a commercial fruit crop, both for table and processing purpose, demands its widespread cultivation. At present guava is cultivated largely through a traditional system under which it is difficult to achieve desired level of production. Now days, high density orcharding system has been standardized in many temperate fruit crops with full package of practices. This concept is also gaining popularity in tropical and subtropical fruit crops such as pineapple (Chaddha *et al.*, 1973), banana (Randhava *et al*., 1973), mango (Majumdar *et al*., 1982; Ram and Sirohi, 1991), citrus (Sharma *et al.*, 1992) and guava (Singh, 2005; Mohammad *et al.*, 1984; Singh *et al.*, 1980).

Under traditional planting system of guava, nutrient management practices have been standardized. Guava tree utilizes nutrients for vegetative growth and fruit production. Some amount of nutrients is fixed in plant in its annual growth. A sizeable quantity of nutrients is permanently removed in the form of fruits. These nutrients must be replenished in the form of manure and fertilizers. Therefore there is an urgent need for standardization of fertilization schedule under high density orcharding system to attain long term sustainability for fruit production as well for maintaining soil productivity. There is scanty information on the nutrient removal by fruits in guava under high density orcharding. Such information's can provide sound basis for formulation of fertilization program in high-density orchards of guava. Hence the present study was attempted to find out nitrogen, phosphorus and potassium removal by fruits of guava trees. Removal of nutrients from plant also takes place through leaf fall, but being a evergreen tree, the amount of leaf fall remains insignificant and fallen leaves get decomposed in the orchard itself and releases the nutrients.

2. Materials and Methods

The study was conducted at Horticultural Research Centre of G B Pant University of Agriculture and Technology, Pantnagar (Uttaranchal). The experimental site was situated at an altitude of 79.3 0 east longitude in the foot hills of Himalayas with humid subtropical climate. The experimental material consisted of five plant densities of guava Cv L-49 (T1-833 plants hectare $^{-1}$; T2-555 plants hectare $^{-1}$; T3-416 plants hectare $^{-1}$; T4-333 plants hectare $^{-1}$ and T5-278 plants hectare $^{-1}$). Each treatment was replicated four times in RBD.

For estimating nutrient removal (kg hectare $^{-1}$), fruit yield data (kg ha $^{-1}$) was estimated for each treatment by multiplying the yield per tree with expected number of plants in one hectare area. Mineral

Table 2: Effect of plant densities on fruit nutrient content of fruits (per cent on dry weight basis) in guava

Treatments	Nitrogen content		Phosphorus content		Potassium content	
	Winter season	Rainy season	Winter season	Rainy season	Winter season	Rainy season
T1	0.484 (4.005)	0.417 (3.702)	0.063 (1.443)	0.061 (1,418)	0.510 (4.097)	0.400 (3,626)
T2	0.517 (4.123)	0.420 (3.716)	0.074 (1.566)	0.062 (1.426)	0.545 (4.233)	0.417 (3.704)
T3	0.585 (4.387)	0.456 (3.873)	0.077 (1.597)	0.062 (1.432)	0.600 (4.442)	0.438 (3.796)
T4	0.686 (4.750)	0.487 (4.001)	0.078 (1.602)	0.064 (1.455)	0.632 (4.561)	0.481 (3.976)
T5	0.695 (4.782)	0.520 (4.135)	0.081 (1.630)	0.065 (1.450)	0.665 (4.677)	0.491 (4.021)
CD at 5%	0.034	0.028	0.043	NS	0.026	0.021
SE	0.011	0.009	0.014	0.003	0.008	0.007

Table 3: Effect of plant densities on nutrient removal (kg/ha) through fruits in guava.

Treatments	Nitrogen Removal (kg/ha)		Phosphorus Removal (kg/ha)		Potassium Removal (kg/ha)	
	Winter season	Rainy season	Winter season	Rainy season	Winter season	Rainy season
T1	66.11	124.66	8.68	18.30	69.69	119.58
T2	58.05	118.91	8.38	17.55	61.25	118.24
T3	60.66	120.44	8.05	16.49	62.22	115.75
T4	70.10	110.49	8.00	14.63	64.64	109.12
T5	75.17	109.92	8.75	13.73	71.93	109.93
CD at 5%	6.45	NS	NS	2.03	6.69	NS
SE	2.09	4.32	0.31	0.67	2.17	4.34

Composition of nutrients in fruit samples was estimated. Total nitrogen was determined by micro-kjeldhal method (AOAC, 1970). From the tri acid digest (conc. Nitric acid, Sulphuric acid and Perchloric acid) in the ratio of 10:1:3 by volume as described by Jackson (1973), phosphorus content of fruits was determined using " vanadomolybdophosphoric yellow colour method" (AOAC, 1970) and potassium was estimated by using flame photo meter and potassium filter. The results were expressed as per cent nitrogen (N), phosphorus (P) and potassium (K) on dry weight basis. The removal of nutrients from the soil was calculated on dry weight basis by using the following formula.

$$\text{Nutrient Removal} = \frac{\text{Per cent concentration in fruit} \times \text{Fruit yield (kg/ha)}}{100}$$

The data were statistically analysed for analysis of variance. The significance of variance among treatments was observed by applying F test and critical difference at 5 per cent level of probability.

3. Results and Discussion

Data presented in Table 3 indicated that there was significant effect of spacing treatments on nitrogen removal through fruits during winter season. The maximum nitrogen removal (75.15 kg ha $^{-1}$) was obtained in T-5. This was due to significantly higher amount of fruit nitrogen availability (0.695 % d/w) under T-5 (Table2). More amount of fruit nitrogen in T-5 might be due to more soil coverage area per tree and thus more nitrogen uptake through roots. Amount of nitrogen removed during rainy season decreased as spacing increased but this difference was non-significant.

Table 1: Effect of plant densities on fruit yield of guava

Plant densities	Fruit yield (t ha^{-1})	
	Winter season	Rainy season
T-1	13.66	29.88
T-2	11.23	28.31
T-3	10.37	26.40
T-4	10.22	22.64
T-5	10.81	21.13
CD at 5%	0.37	1.03
SE	1.15	3.18

Phosphorus removal through fruits during winter season was non-significant. This may be due to considerably less movement of phosphorus from soil to plant system during winters due to low temperature (Raja and Singh, 1990). The release of inorganic phosphate from organic phosphates is called mineralization and is caused by microorganisms which break down organic compounds. The activity of

microorganisms is highly influenced by soil temperature and soil moisture. The process is more rapid when soils are worm and moist but well drained. This process slows down during winters. Highest phosphorus removal through fruits (18.30 kg ha $^{-1}$) during rainy season was reported in T-1. This might be due to significantly higher fruit yield (29.88 t ha $^{-1}$) in this treatment resulting in more phosphorus uptake for formation of fruits. More phosphorus removal in T-1 also might be due to formation of higher number of seeds (on hectare basis) resulting in more utilization of phosphorus because it plays a major role in seed development (Prakash, 1980).

During winter season, significantly higher amount of potassium (71.93 kg ha $^{-1}$) was removed through fruits in T-5. This might be due to presence of significantly higher amount of fruit potassium content (0.665 % d/w) in T-5 (Table 2) which ultimately resulted in more potassium removal when calculated with fruit yield data (10.81 t ha $^{-1}$) as shown in Table1. Potassium removal through fruits during rainy season was non-significant.

More removal of nutrients (N, P and K) during rainy season might be due to 2-2.5 times more fruit yield which is directly related with nutrient removal. Shikhamany *et al.* (1986) also reported that about 2.59 times more fruit yield is obtained during rainy season. Singh and Singh (2004) conducted similar type of study on nutrient removal by pear fruits.

4. Conclusion

It was found that fruits were a major source of removal of N, P and K. It is concluded from above discussion that the fruits of guava tree removes high amount of N, P and K from the soil. In order to produce a heavy crop year after year, these nutrients must be replenished in the form of manure and fertilizers.

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