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Split application of inorganic fertilizers for rainy and winter season crops in guava cv. L-49

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ABSTRACT

The number of fruits, yield, fruit size and weight of rainy season crop of guava cv. L-49 was significantly improved with split application of inorganic fertilizers. Application of 50 per cent higher fertilizers in three splits than control exhibited increment of 43.2, 34.0, 38.5 and 41.3 per cent in yield and 23.6, 27.5, 38.7 and 40 per cent in fruit weight during rainy season crop (2010 to 2013). In winter season, the consequent increase in yield was only 11.3, 6.4 and 20.7 per cent with the same dose and splits of fertilizers than control in 2010, 2012 and 2013, respectively. In winter season, the split application had no significant effect on fruit weight except during first year of application. The TSS of fruits in all treatments was not significantly affected except in winter crop of first year under recommended dose of fertilizers in three splits. The acidity of fruits during rainy season crop was also not influenced significantly except 4th year of observations, while, the fruits under T_1 treatment exhibited highest fruit acidity during winter season of all years. The rainy season fruits obtained from plants with higher dose of fertilizers were significantly more palatable than fruits of control plants, while, the palatability rating of winter season fruits was higher in control during second and third year of observations. It was concluded that the fruit yield and quality of rainy season crop was significantly improved with higher doses of split application of inorganic fertilizers.

Key words: Fruit quality, guava, nitrogen, phosphorus, potassium, yield.

INTRODUCTION

Guava (*Psidium guajava* L.) is an important fruit of tropical and subtropical areas of the world. Guava is known as 'Apple of Tropics' owing to the fact that it is only fruit that matches the high nutritive value of apple, an important temperate fruit. Presently, guava occupies an area of 0.24 million hectare with annual production of 3.2 M mt in India (Anon, 2). Guava has also become an important fruit crop of Punjab and it ranks second after citrus occupying an area of 8,072 ha with annual production of 0.18 M mt (Anon, 3). Guava is a good source of vitamin C, A, B1 (riboflavin) and minerals like calcium, phosphorus and iron. It contains about 180-300 mg of vitamin C per 100 g of pulp. Guava fruits are used for making jam and jelly. It contains antioxidant factors and can control systolic blood pressure.

In Punjab, guava bears two crops, *i.e.* rainy season and winter season crop. However, it is recommended to take only winter season crop as the rainy season crop is severely damaged by the fruit fly. However, this practice is not followed by the farmers due to economic concerns. The fruit yield of one crop either winter or rainy is adversely affected under this system of cropping; as it is recommended to apply fertilizers only for taking winter season crop. The dose, time and method of application of fertilizers markedly influence the absorption and utilization of applied nutrients in fruit crops. The variation in recommended dose of fertilizer in response to different trials may be associated with soil factor, plant age and the crop growth (Singh and Singh, 11). Many researchers suggested that the fertilizer application should preferably be made every four months to coincide with the stages of heavy nutrient demand. There are normally two peak harvests over one year and it is recommended that the timing of the application be scheduled at one month prior to the new flush of flowering. The dosage of fertilizer per annum must be equally split into three parts for each application in guava (Chan and Tee, 5). Mitra and Bose (10) also suggested application of fertilizers to guava in January and August in two equal split doses. Hence, the present study was conducted to apply the nutrition in split doses for improvement of fruit quality.

MATERIALS AND METHODS

Four-year-old plants of guava cv. L-49, bearing first commercial crop were subjected to application of inorganic fertilizers for exploring the possibilities of taking higher yield of good quality fruits from both rainy as well as winter season crop. As per the already recommended fertilizer schedule for guava

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under Punjab conditions (Anon, 2). The application of N: P: K was given in the form of urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O) to young plants with the initiation of first year of commercial fruiting in two splits as a control; first half was applied in May-June and second half in September-October. In treatment T_1, the same doses of fertilizers as that of control were applied in three splits, in second treatment (T_2), fertilizers were applied in three splits by increasing 50 per cent dose than control fertilizers and in third treatments(T_3), fertilizers were applied in three splits by increasing 75 per cent dose than control fertilizers. The dose of N: P: K fertilizers were increased accordingly with the age of the trees upto 4th year of commercial fruit bearing.

Age of plant (year)	Control	T_1	T_2	T_3
	RDF in two splits (urea:SSP:MOP)	RDF in in three splits (urea:SSP:MOP)	50% higher fertilizers than recommended in 3 splits (urea:SSP:MOP)	75% higher fertilizers than recommended in 3 splits (urea:SSP:MOP)
04 (2010)	300:1500:600	300:1500:600	450:2250:900	525:2625:1050
05 (2011)	450:1750:800	450:1750:800	675:2625:1200	750:3050:1400
06 (2012)	600:2000:1000	600:2000:1000	900:3000:1500	1050:35000:1750
07(2013)	750:2000:1100	750:2000:1100	1125:3000:1650	1300:3500:1925
Time of application	½ May-June ½ September-October	1/3rd February-March 1/3rd June-July 1/3rd September-October		

RDF = Recommended dose of fertilizer

The number of fruits from each experimental plant was counted before harvest and average was worked out. The length and breadth of ten randomly selected mature fruits were recorded with the help of Vernier calipers and the means were worked out. To determine palatability rating (PLR), fruits were picked and scored for colour, size, flavour and aroma by panel of five judges. The treatments scoring more points were rated as superior to those having less point. The total soluble solids content of juice were recorded with the help of Baush and Lamb hand refractometer (0-32 per cent). The acidity was expressed in terms of citric acid by using following formula (AOAC, 1).

RESULTS AND DISCUSSION

The number of fruits and yield per plant was significantly increased during rainy season in all years of observations. The number of fruits (471 and 457) and yield (37.93 and 36.86 kg/ plant) during first rainy season of fruit bearing, in T_3 and T_2 was significantly higher than control and T_1 treatment as evident from Table 1. Similarly, in first winter season, number of fruits (446) and yield (56.08 kg/plant) were maximum in T_3 followed by 49.85 kg/plant in T_2 and least (35.70 kg) in T_1 treatment. Increment of 44.79 and 21.15% yield per plant was recorded in rainy (Fig. 1) and winter (Fig. 2) season crop in T_3 treatment than control, respectively. However, in second year rainy and winter season, the number of fruits was maximum, *i.e.* 553 and 479, respectively in T_2 treatment (Table 3). Fruit yield was also recorded maximum in T_2 (52.60 kg) during rainy season, but in winter season, yield was recorded maximum in control plants (60.54 kg). Although, the increment of 33.92% in yield was recorded in T_2

Table 1. Effect of split application of fertilizers on physical characters of rainy and winter season fruits of guava during the year 2010**.**

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	1st year (rainy season)					1st year (winter season)				
Fruit number	351	457	471	339	30.81	315	422	446	431	43.43
Fruit length (cm)	5.33	5.54	5.54	5.20	0.06	6.15	6.38	6.41	6.08	0.06
Fruit breadth (cm)	5.11	5.47	5.48	5.07	0.05	6.01	6.12	6.22	5.99	0.05
Fruit weight (g)	62.53	80.66	80.54	61.70	4.41	113.33	118.13	125.83	102.60	10.70
Fruit yield (kg/plant)	21.93	36.86	37.93	20.94	7.69	35.70	49.85	56.08	44.22	10.28

during rainy season but there was 7.02% decline in yield during winter season than control (Fig. 1). During third year of fruit bearing (Table 5), the number of fruit per plant in T_2, T_3 and control (Table 5) were significantly higher during rainy and winter season than T_1. However, the yield of rainy season crop in control plants was significantly less (43.87 kg) than T_2 (71.26 kg) and T_3 (70.29 kg). However, in winter season, the yield of control plants was significantly at par with T_2 and T_3 treatments. Increase of 38.74 and 37.87 per cent yield than control in T_2 and T_3 was recorded during rainy season (Fig. 1), but, in winter, yield was slightly lesser than control plants. Likewise, in the rainy season crop of the year 2013 (Table 7), the number of fruits in all treatments and control was not altered significantly but yield of control plants was significantly less (47.93 kg) than all treatments. Similarly, the winter crop of the same year exhibited significantly higher fruit numbers (675 and 628) and yield (89.59 and 82.47 kg) in T_2 and T_3 than control, respectively. Although, the increase of more than 40 per cent yield in T_2 and T_3 than control was recorded during rainy season (Fig. 1), but, it was lesser in winter season (Fig. 2). Higher availability of nutrients leads to increased fruit number and yield during rainy season. Increasing the fertilizer amount resulted in increase in number of fruits per plant (Jose *et al*., 7). Fruit size and weight during both seasons was also significantly affected with dose and time of fertilizer applications. During first year of investigation, the length, breadth and weight of rainy season fruits in T_2 and T_3 was significantly higher than control and T_1 (Table 1). Similarly, during winter season, the length (6.41 cm), breadth (6.22 cm) and weight (125.83 g) of fruits was highest in T_3 followed T_2 (Table 1). During second year (Table 3), fruit size weight (98.60 g) in T_3 was significantly highest in rainy season followed by T_2 treatment. Control plants exhibited the smallest fruit size and minimum fruit weight. However, in winter season maximum fruit weight was recorded in control plants (126.73 g) followed by T_3 (124.27 g) and T_2 (118.10 g). The size (5.79 cm length and 5.70 cm^2 breadth) and weight (107.43 g) of rainy season fruits was also less in control plants than all treatments during third year of study (Table 5), but, in winter season maximum fruit length (6.44 cm) and breadth (6.37 cm) was recorded in T_3, while, fruit weight (129.47 g) was recorded maximum in control plants. In rainy season of 2013 (Table 7), fruit size and weight was also significantly less in control plants than all other treatments with maximum fruit weight (118.37 g) in T_3 followed by 114.90 g in T_2 and 102.47 g in T_1 treatment. However, in winter season fruit size (6.48 cm length and 6.40 cm breadth) and weight (133.1 g) were highest in control plants. Increase in fruit size and weight may be due to more availability of essential nutrients to the developing fruits, similarly, application of N:P:K only for winter season crop resulted on better fruit size and weight under control treatment.

Although, the TSS and acidity of rainy season fruits in all treatments and control was not affected significantly, but fruits of T_3 and T_2 were more palatable than T_1 and control (Table 2). However, during winter season, PLR of T_3 was maximum (8.30) followed by T_2 (8.25). Similarly, in second year, the TSS and acidity of rainy season fruits was not affected significantly, but the palatability rating (PLR) was significantly more in all treatments than control (Table 4). However, in winter season TSS and PLR of control fruits was higher than all treatments. The fruits of control plants were also significantly less acidic than treatments. In third year, the palatability rating of rainy season fruits was maximum (7.89) in T_2 followed by T_3 (7.81) and minimum in control (6.77) plants (Table 6). However, in winter season PLR was not affected significantly. Similarly, TSS was also significantly higher in treatments than control during rainy season, but, in winter TSS was not affected significantly. The fruits of control plants were significantly less acidic than all other treatments during winter season. Similarly, in 4^{th} year (Table 8) the PLR and TSS of rainy season crop was also significantly less in control plants but, in winter season the PLR (8.46) and TSS (11.33%) in control plants was highest. The fruits of rainy season were more acidic while, in winter season acidity of fruits of T_1 plants was significantly more than other treatments and control. Increasing the fertilizer amount resulted in reduced fruit weight and increase in number of fruits per plant (Jose *et al*., 7). The positive effect of N may be due to its role as an important constituent of many important structural, genetic and metabolic compounds in plant cells. Nitrogen is a component of energy transfer compounds, such as ATP (adenosine tri-phosphate), which allow cells to conserve and use the energy resulted in metabolism as mentioned (Don, 6). The effect of potassium in this respect may be due to its vital role in photosynthesis translocation of photosynthates, protein synthesis, control of ionic balance, regulation of plant stomata and water use, activation of plant enzymes and many other processes along with activation of at least 60 enzymes involved in plant growth and development (Bob, 4). Earlier, Keshvamurthy and Kotur (8) suggested July application to give better results. This may also be due to greater number of active roots being present in zone during summer (Kotur *et al.*, 9). Singh and Singh (11) also reported that the 583:271:400 g of N: P: K per plant is optimum for the guava. Hence, the fruit yield and

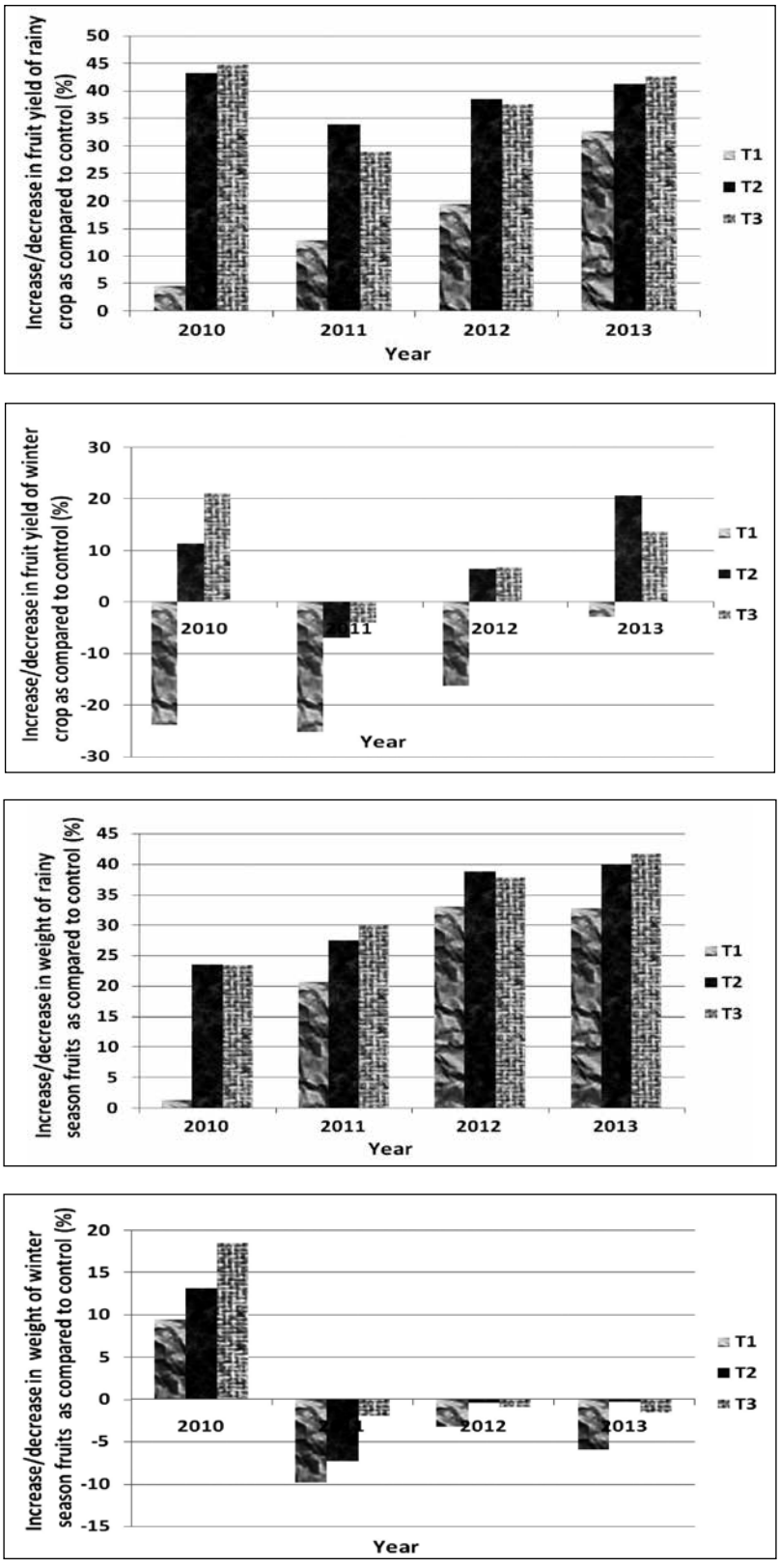

Fig. 1. Increase /decrease in fruit weight and yield as compared to control due to fertilizer application in splits during rainy and winter season crops in guava.

Table 2. Effect of split application of fertilizers on chemical characters of rainy and winter season fruits of guava during 2010.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	1st year (rainy season)					1st year (winter season)				
PLR (out of ten)	7.04	7.18	7.22	7.05	0.04	8.12	8.25	8.30	8.18	0.10
TSS (%)	10.11	10.05	10.09	10.22	NS	10.13	10.50	10.53	10.42	0.19
Acidity (%)	0.24	0.23	0.23	0.22	NS	0.185	0.168	0.163	0.174	0.01

Table 3. Effect of split application of fertilizers on physical characters of rainy and winter season fruits of guava during 2011.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	2nd year (rainy season)					2nd Year (winter season)				
Fruit number	459	553	496	503	18.1	419	479	468	478	37.74
Fruit length (cm)	5.68	5.74	5.75	5.32	0.12	6.16	6.37	6.37	6.49	0.19
Fruit breadth (cm)	5.28	5.60	5.64	5.24	0.09	6.02	6.15	6.24	6.31	0.13
Fruit weight (g)	87.07	95.17	98.60	69.07	3.78	115.36	118.13	124.27	126.73	4.97
Fruit yield (kg/plant)	39.93	52.60	48.94	34.76	8.67	48.36	56.57	58.20	60.54	14.26

Table 4. Effect of split application of fertilizers on chemical characters of rainy and winter season fruits of guava during 2011.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	2nd year (rainy season)					2nd year (winter season)				
PLR (out of ten)	7.45	7.44	7.55	6.72	0.31	8.03	8.17	8.18	8.30	0.13
TSS (%)	10.13	10.17	10.20	10.13	NS	10.55	10.72	10.82	11.10	NS
Acidity (%)	0.233	0.227	0.233	0.223	NS	0.190	0.177	0.187	0.170	0.01

Table 5. Effect of split application of fertilizers on physical characters of rainy and winter season fruits of guava during 2012.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	3rd year (rainy season)					3rd year (winter season)				
Fruit No.	555	663	664	667	74.1	470	567	572	529	84.5
Fruit length (cm)	5.44	5.78	5.79	5.15	0.12	6.44	6.44	6.36	6.40	NS
Fruit breadth (cm)	5.35	5.65	5.70	5.17	0.09	6.28	6.37	6.29	6.30	NS
Fruit weight (g)	98.30	105.80	107.43	65.80	2.76	125.40	129.00	128.37	129.47	NS
Fruit yield (kg/plant)	54.52	71.26	70.29	43.87	NS	58.90	73.14	73.43	68.48	10.06

Table 6. Effect of split application of fertilizers on chemical characters of rainy and winter season fruits of guava during 2012.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	3rd year (rainy season)					3rd year (winter season)				
PLR (Out of ten)	7.72	7.89	7.81	6.77	0.44	8.23	8.25	8.30	8.41	NS
TSS (%)	10.23	10.27	10.30	9.97	0.19	10.55	10.95	10.93	11.23	NS
Acidity (%)	0.217	0.207	0.207	0.227	NS	0.187	0.170	0.163	0.153	0.01

Table 7. Effect of split application of fertilizers on physical characters of rainy and winter season fruits of guava during 2013.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	4th year (rainy season)					4th year (winter season)				
Fruit number	694	710	706	696	NS	550	675	628	534	71.65
Fruit length (cm)	5.86	5.97	6.02	5.22	0.09	6.50	6.44	6.43	6.48	NS
Fruit breadth (cm)	5.55	5.82	5.82	5.15	0.06	6.35	6.37	6.34	6.40	NS
Fruit weight (g)	102.47	114.90	118.37	68.90	3.25	125.6	132.7	131.1	133.1	5.39
Fruit yield (kg/plant)	71.11	81.62	83.57	47.93	8.98	69.18	89.59	82.47	71.13	10.52

Table 8. Effect of split application of fertilizers on chemical characters of rainy and winter season fruits of guava during 2013.

Parameter	T_1	T_2	T_3	Control	LSD (5%)	T_1	T_2	T_3	Control	LSD (5%)
	4th year (rainy season)					4th year (winter season)				
PLR (out of ten)	7.89	8.00	8.00	6.88	0.48	8.21	8.33	8.44	8.46	0.12
TSS (%)	10.37	10.64	10.61	10.07	0.18	10.85	11.12	11.02	11.33	NS
Acidity (%)	0.213	0.217	0.190	0.220	0.017	0.193	0.170	0.153	0.156	0.016

quality of rainy season crop was significantly improved with higher doses of split application of inorganic fertilizers than control treatment.

REFERENCES

1. A.O.A.C. 2000. *Official Methods of Analysis* (17th Edn.), Association of Official of Analytical Chemists, P.O. Box 540, Washington, D.C., USA.
2. Anonymous. 2013. *Indian Horticulture Database*, National Horticulture Board, Gurgaon (*www.nhb.gov.in*).
3. Anonymous. 2014. *Area, Production and Productivity of Fruits in Punjab*, Directorate of Horticulture, Government of Punjab.
4. Anonymous. 2015. *Guava: Package of Practices for Cultivation of Fruits*, Punjab Agricultural University, Ludhiana, pp. 31-38.
5. Bob, T. 2001. *Efficient Fertilizer Use Potassium*, *IMC Global* (4th Edn.), IIlinois, USA, pp. 92-104.
6. Chan, Y.K. and Tee, T.S. 1976. The Cultivation of Guava (*Psidium guajava* L.). Malaysia, *MARDI Report No*. **45**, pp. 23.
7. Don, E. 2001. *Efficient Fertilizer Use Nitrogen*, *IMC Global* (4th Edn.), Illinois, USA, pp. 66-84.
8. José, L.M., José D., Neto, P. and Fernandes, D. 2007. Response functions of the guava to water depth and nitrogen fertilization. *Brazilian Mag. Fruit Cult.* **29**: 323-28.
9. Keshavamurthy, S.V. and Kotur, S.C. 1999. Fertilizer use efficiency in citrus, grapes, mango and guava as influenced by time of application and placement method. *Karnataka J. Agril. Sci.* **11**: 1023-29.
10. Kotur, S.C., Keshava Murthy, S.V. and Iyenger, B.R.V. 1996. Root activity distribution studies in Arka Mridula guava (*Psidium guajava* L.) using carrier-free ^{32}P isotope. Paper presented at *DAE-BARC Symposium on Nuclear Techniques in increasing Crop and Animal Productivity*, BARC, Mumbai, October, 7-9, 1996, BARC, Mumbai.
11. Mitra, S.K. and Bose, T.K. 1985. Effect of varying levels of nitrogen, phosphorus and potassium on yield and quality of guava (*Psidium guajava* L.) var. L-49. *South Indian Hort.* **33**: 286-92.
12. Singh, H.P. and Singh, G. 2007. Nutrient and water management in guava. *Acta Hort.* **735**: 389-98.

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