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EFFECTS OF DOSES AND SPLITS OF FERTILIZER APPLICATION ON HARVESTING TIME, YIELD AND QUALITY OF MANGO cv. AMRAPALI*

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Abstract

The experiment was carried out at the Germplasm Centre of Bangladesh Agricultural University, Mymensingh during the fruiting season of 2005-06 to investigate the effects of fertilizer and its installment of application on harvesting time, yield and quality of fruits of 8 years old mango plant cv. Amrapali. Four fertilizer doses i.e. T_1 : 50% of the fertilizer dose (cowdung $_{12.5\ kg}$, urea $_{375\ g}$, TSP_{200g}, $MoP_{125\ g}$, gypsum $_{125\ g}$ and zinc sulphate $_{7.5\ g}$ per plant), T_2 : 100% of the fertilizer dose (cowdung $_{25\ kg}$, urea $_{750\ g}$, $TSP_{400\ g}$, MoP $_{250\ g}$, gypsum $_{250\ g}$ and zinc sulphate $_{15\ g}$ per plant), T_3 : 150% of the fertilizer dose (cowdung $_{37.5\ kg}$, urea $_{1125\ g}$, TSP $_{600\ g}$, MoP $_{375\ g}$, gypsum $_{375\ g}$ and zinc sulphate $_{22.5\ g}$ per plant), and T_4 : control (no fertilizer) and three splits of application i.e. A_1 : One installment (whole fertilizer applied on 15 September), A_2 : Two installments (15 September and 15 March) and A_3 : Three installments (15 September, 15 March and 15 May) were included as treatments. Plants receiving 150% of the fertilizer dose in three installments caused delayed harvest by 11 days compared to control than that of the control. Plants treated with 150% of fertilizer dose in combination with three installments produced the highest number of fruits (96/ plant) as well as the highest yield (19.55 kg/plant) as compared to control (23/ plant and 3.48 kg/plant). Applying fertilizer at 150% of the fertilizer dose in three installments improved the fruit quality with regard to TSS, pH, titratable acidity, vitamin C, moisture content, dry matter content, reducing sugar, non reducing sugar and total sugar content over control. Thus, this treatment may be recommended for fertilizer management in mango cultivation.

Keywords: Effects of doses, splits of fertilizer dose, mango.

Introduction

Irregular flowering, low fruit set and low fruit retention leading to low yield and poor quality fruits are the major constraints in mango production. Among the factors that influence crop production, fertilizer is the most important one. In Bangladesh, the mango trees mostly in the homestead and the trees in the orchard hardly receive any fertilizer (Hossain, 1989). Larger and heavier fruits were produced by the combined application of fertilizer, no irrigation and spraying

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with 10 g KNO_3/litre water in Philippines. High pH and TSS values were found in fruits of non-irrigated, fertilized trees sprayed with 20 g KNO_3/litre water (Bhuiyan and Irabagon, 1992). The highest total yield of mango cv. Nam Dok Mai in Thailand was obtained with 0.5 kg N, 0.4 kg P, and 1.5 kg K/tree and TSS content with 1.0 kg N, 0.2 kg P and 1.5 kg K/tree (Suriyapananont and Subhadrabandhu, 1992). The highest fruit yield, fruit weight and pulp weight were recorded for the treatment of 800 g N, 200 g P, and 300 g K in mango cv. Dashehari, Punjab, India (Sharma *et al.*, 2000). Nitrogen application significantly influenced the fruit yield of young 'Totapuri' mango trees at Bangalore, India while P and K application did not (Reddy *et al.*, 2000). Yield and quality of mango were improved with 400 N, 125 P, 440 K, 40 Mg, and 80 S (in g/tree/year) in Guangdong, China (Zhou *et al.*, 2001). Application of N, P, and K per plant per year markedly increased the number of fruits/plant, yield, pulp content and also improved fruit quality in West Bengal, India (Satapathy and Banik, 2002). The application of 500 g K per tree in 3 equal splits was the best treatment with regard to fruit yield and quality parameters in Egypt (Fouad *et al.*, 2003). El-Wakeel (2005) indicated that urea at 500 or 1000 g N per tree and potassium sulfate at 400 g K_2O per tree, registered the greatest fruit weight, length, width and thickness in mango (cv. Amrapali) at Dibba Al-Fujira, United Arab Emirates. Little is known of the current fertilizer practices for mango grown in homestead and commercially in the orchard in Bangladesh. The present study was therefore undertaken to find out the effects of fertilizer and its installment of application at different stages of plant growth on harvesting time, yield and quality of mango.

Materials and Method

The experiment was carried out at the Germplasm Centre, Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh during the fruiting season of 2005-06. Investigations related to bio-chemical analysis were carried out in the Department of Biochemistry of BAU, Mymensingh. The eight years old Amrapali plants with a plant spacing of 5x5m were used in the study. The factorial experiment was laid out in a Randomized Complete Block Design with three replications. Fertilizer at the rate of cowdung $_{25\ kg}$, urea$_{750g}$, $TSP_{400\ g}$, MoP $_{250\ g}$, gypsum $_{250\ g}$ and zinc sulphate $_{15\ g}$ per plant proposed in the Manual on mango cultivation in Bangladesh by Hossain, (1989) were used as fertilizer dose in the study. Four fertilizer doses i.e. T_1 : 50% of the fertilizer dose (cowdung $_{12.5\ kg}$, urea $_{375\ g}$, TSP_{200g}, $MoP_{125\ g}$, gypsum $_{125\ g}$ and zinc sulphate $_{7.5\ g}$ per plant), T_2 : 100% of the fertilizer dose (cowdung $_{25\ kg}$, urea $_{750\ g}$, $TSP_{400\ g}$, MoP $_{250\ g}$, gypsum $_{250\ g}$ and zinc sulphate $_{15\ g}$ per plant), T_3 : 150% of the fertilizer dose (cowdung $_{37.5\ kg}$, urea $_{1125\ g}$, TSP $_{600\ g}$, MoP $_{375\ g}$, gypsum $_{375\ g}$ and zinc sulphate $_{22.5\ g}$ per plant), and T_4 : control (no fertilizer) along with three splits of application i.e. A_1 : One installment (whole fertilizer applied at a time on 15 September), A_2 :

Two installments (15 September and 15 March) and A_3 : Three installments (15 September, 15 March and 15 May) were included as treatments. Basin type very light furrows were prepared around and 1.0 meter away from the base of each plant. Fertilizers were applied in the furrows and then thoroughly mixed up with the soil. In one installment (A_1), the whole fertilizer was applied at a time on 15 September. In case of two installments (A_2), the total amount of cowdung, TSP, gypsum and zinc sulphate and ½ of urea and ½ of MoP was applied on 15 September and the rest amount of urea and MoP applied on 15 March. In the case of three installments (A_3), the total amount of cowdung, TSP, gypsum and zinc sulphate and ½ of urea and ½ of MoP was applied on 15 September, then ½ of the remaining amount of urea and MoP was applied as second installment on 15 March and the rest urea and MoP were applied as 3rd and final installment on 15 May. Very light irrigation was given at each time of fertilizer application. Very light irrigation was also provided to control (no fertilizer) plants in each time of fertilizer application. The parameters recorded were date of harvest, number of fruits per plant, fruit weight, length, breath and thickness, yield, edible portion, stone pulp ratio, peel pulp ratio, shelf-life, TSS, titratable acidity, vitamin C, dry matter, reducing sugar, non reducing sugar and total sugar content. After harvest, 10 randomly selected fruits were allowed to ripen at room temperature and fruit quality was determined using 10 fruits per tree. Total Soluble Solid (TSS) of 10 fully ripened fruits for each treatment was estimated by a hand refractometer and the average was worked out. The titratable acidity, vitamin C content, reducing sugar content and total sugar content of mango pulp were determined following the methods of Ranganna (1979) Plummer (1971), Miller, (1972) and Jayaraman (1981) respectively. The data were analyzed statistically by F-test and the treatment means were separated by Least Significant Difference (LSD) test at 5 % level of significance.

Results and Discussion

Effect on harvest time

Date of harvest varied from 24 June 2006 to 05 July 2006 having the earliest harvest in control plants and the delayed harvest in plants treated with 150% of the fertilizer dose applied in three installments (Table 3). The delayed harvest might be due to proper availability of nutrients for longer period as 150 % of the fertilizer dose was applied in three splits.

Effect on number of fruits

The results revealed that fertilizer dose, installment of application and their combined effect exerted significant influence in terms of number of fruits per plant (Tables 1, 2 & 3). The maximum number of fruits per plant was recorded (86.00) in 150% of fertilizer dose and the minimum number of fruits was noted

in control plants (26.44). Applying fertilizer to mango plants in three installments resulted in the highest (68.92) number of fruits per plant while one installment produced the lowest number of fruits (49.83). Plants treated with 150% of fertilizer dose in combination with three installments had the highest number of fruits (96.00) per plant which was followed by T_2A_3 (89.00) and T_3A_2 (85.33), whereas the control plants recorded the lowest number of fruits (23.00). The superior performance due to the application of proper fertilizer (150% of the dose) in the present study has got the similarity with the findings of Satapathy and Banik (2002) who opined that application of 100 g each of N, P, and K per mango plant cv. Amrapali per year in West Bengal, India, markedly increased the number of fruits/plant.

Effect on fruit yield

The impacts of fertilizer dose and installment of application on mango yield was noted significant (Table 1, 2 & 3). Irrespective of doses, fertilizer treated plants manifested higher yield compared to control. There was an increasing trend of yield with the increased dose of fertilizers. The highest yield (15.82 kg/plant) was noted in the treatment 150% of fertilizer dose compared to the lowest yield (4.15 kg/plant) in control plants. An increasing trend in yield was observed with the increase of number of installments for applying fertilizer. The maximum yield (12.41 kg/plant) was obtained when the fertilizer was applied in three installments and the plants treated with whole fertilizer at a time produced the minimum yield (7.57 kg/plant). The treatment 150% of fertilizer dose combined with three installments of its application demonstrated the highest yield (19.55 kg/plant) while the second highest yield was obtained from the treatment combination of 150% of fertilizer dose and two installments of application (16.02 kg/plant) which was statistically identical to that of 100% of fertilizer dose and three installments of application (15.85 kg/plant). The least yield was obtained from the control plants (3.48 kg/plant). The increased number of fruits per plant in the treatment combination of 150% of the fertilizer dose and three installments obviously, had favourable effects on culminating higher yield. The increased fruit yield due to frequent fertilizer application was also reported by Feungchan *et al*. (1989). Sharma *et al.* (2000) reported the highest fruit yield, heaviest fruit and pulp weight at Gurdaspur, Punjab, India from the treatment 800 g N, 200 g P and 300 g K, which give support to the present higher yield and fruit weight from 150% of the fertilizer dose. Muriate of potash (MoP) applied in 3 splits in the present study resulted in maximum yield due to availability of K for long time has been supported by Kanwar *et al*. (1987), who opined that K was highly beneficial with regard to yield.

Table 1. Influence of fertilizers on the number of fruits and fruit characters of mango.

Fertilizer dose	No. of fruits/ plant	Fruit				Edible portion (%)	Stone pulp ratio	Peel pulp ratio	Shelf-life
		Weight (g)	Length (cm)	Breadth (cm)	Thick-ness (cm)				
50% of fertilizer dose	48.44	164.16	8.91	6.09	5.47	61.24	0.29	0.28	8.97
100% of fertilizer dose	73.89	174.82	9.05	6.20	5.56	65.34	0.26	0.24	8.86
150% of fertilizer dose	86.00	194.47	9.46	6.51	5.72	66.36	0.25	0.25	8.72
Control (no fertilizer)	26.44	160.70	8.59	6.22	5.53	59.48	0.35	0.31	7.06
CV(%)	8.06	6.27	6.21	3.31	3.07	3.58	6.22	6.63	10.28
LSD (0.05)	4.62	10.63	0.55	0.20	0.17	2.21	0.01	0.01	0.84

Table 2. Influence of installment of fertilizer application on the number of fruits and fruit characters of mango.

Installment of application	Number of fruits per plant	Fruit				Edible portion (%)	Stone pulp ratio	Peel pulp ratio	Shelf life
		Weight (g)	Length (cm)	Breadth (cm)	Thick-ness (cm)				
One installment	49.83	163.32	8.49	6.07	5.42	62.25	0.31	0.29	8.16
Two installments	57.33	175.89	9.08	6.31	5.61	63.02	0.28	0.27	8.56
Three installments	68.92	181.40	9.44	6.39	5.69	64.03	0.27	0.25	8.49
CV(%)	8.06	6.27	6.21	3.31	3.07	3.58	6.22	6.63	10.28
LSD (0.05)	4.00	9.21	0.47	0.17	0.14	-	0.01	0.01	-

Table 3. Combined effect of fertilizer and its installment of application on the number of fruits and fruit characters of mango.

Fertilizer dose	Installment of application	Date of harvest	No. of fruits/ plant	Fruit				Edible portion (%)	Stone pulp ratio	Peel pulp ratio	Shelf life
				Weight (g)	Length (cm)	Brea-dth (cm)	Thick-ness (cm)				
50% of fertilizer dose (T_1)	One installment	25.06.06	40.33	162.28	8.75	5.99	5.43	60.27	0.32	0.30	9.00
	Two installments	25.06.06	46.33	163.88	8.89	6.09	5.46	61.55	0.29	0.29	8.83
	Three installments	29.06.06	58.67	166.33	9.10	6.20	5.52	61.89	0.27	0.26	9.07
100% of fertilizer dose (T_2)	One installment	25.06.06	59.33	165.28	8.70	6.19	5.49	64.74	0.28	0.27	8.44
	Two installments	27.06.06	73.33	177.93	9.18	6.20	5.56	65.12	0.25	0.24	9.50
	Three installments	03.07.06	89.00	181.25	9.27	6.22	5.62	66.16	0.24	0.22	8.65
150% of fertilizer dose (T_3)	One installment	26.06.06	76.67	165.60	8.58	6.22	5.46	64.86	0.28	0.27	8.86
	Two installments	29.06.06	85.33	200.78	9.56	6.65	5.81	65.95	0.24	0.25	8.55
	Three installments	05.07.06	96.00	217.03	10.24	6.67	5.90	68.27	0.22	0.23	8.75
Control (T_4)	One installment	24.06.06	23.00	160.11	7.93	5.87	5.29	59.14	0.36	0.32	6.33
	Two installments	24.06.06	24.33	160.98	8.68	6.29	5.60	59.48	0.35	0.31	7.33
	Three installments	24.06.06	32.00	161.00	9.15	6.49	5.71	59.82	0.35	0.31	7.50
CV(%)		-	8.06	6.27	6.21	3.31	3.07	3.58	6.22	6.63	8.38
LSD (0.05)		-	8.01	18.42	0.95	0.35	0.29	3.83	0.03	0.03	1.41

Effect on fruit characters

Fertilizer dose and the combined effect with application installments had significant influence on individual fruit weight, length, breadth and thickness, edible portion, stone pulp ratio, peel pulp ratio and shelf-life of fruits (Table 1&3). The installment of fertilizer application attained a significant variation with respect to all above traits except edible portion and shelf-life (Table 2). Among different treatments, 150% of fertilizer dose produced the heaviest individual fruit (194.47 g) and the treatment 100% of fertilizer dose showed the second highest fruit weight (174.82 g), while the control plants produced the lowest fruit weight (160.70 g). The plants treated with fertilizers in three installments gained the maximum individual fruit weight (181.40 g) as against the minimum fruit weight (163.32 g) in the single application of whole fertilizer. The treatment combination of 150% of fertilizer dose and three installments manifested the biggest fruit (217.03 g), which was statistically at par with that of the combination of 150% of fertilizer dose and two installments (200.78 g) of application. The lowest fruit weight was noted in control (160.11 g). The length of fruit increased with the increment of fertilizer doses. The longest fruit (9.46 cm) was observed in plants treated with 150% of fertilizer dose, followed by 100% of fertilizer dose (9.05 cm), whereas the control plants had the shortest fruit (8.59 cm). It was observed that three installments of application exhibited the longest fruit (9.44 cm), while one installment showed the shortest (8.49 cm) fruit. The treatment 150% of fertilizer dose combined with three installments of application attained the longest fruit (10.24 cm). The shortest fruit was recorded in control plants (7.93 cm). Similar trend like fruit length was observed in fruit breath. It ranged from 6.51 to 6.09 cm being the widest fruit in the treatment 150% of fertilizer dose and the narrowest fruit in 50% of fertilizer dose. Fruit breadth was also found to be increased with the increased number of installments. Three installments of application gave the highest fruit breadth (6.39 cm). The maximum fruit breadth (6.67 cm) was noticed in the treatment combination of 150% of fertilizer dose along with three installments of application as against the minimum breadth (5.87 cm) in control.

Among the fertilizer doses, plants treated with 150% of fertilizer dose showed higher fruit thickness (5.72 cm), which was followed by 100% of fertilizer dose (5.56 cm) as compared to 50% of fertilizer dose (5.47 cm). Three installments of fertilizer application continued to record the highest fruit thickness (5.69 cm), followed by two installments of application (5.61 cm) as against the minimum thickness (5.42 cm) in single application of whole fertilizer. The combination of 150% of fertilizer dose and three installments of application resulted in the thickest fruit (5.90 cm) and the control plants produced the thinnest fruit (5.29 cm). The highest fruit weight, length, breadth, and thickness obtained from the plants treated with 150% of fertilizer dose, where 1125 g urea

(518.43 g N) per plant were included corroborates the findings of El-Wakeel (2005), who reported that urea at 500g N per mango (cv. Amrapali) tree at Dibba Al-Fujira, United Arab Emirates, gave the greatest fruit weight, length, width and thickness, respectively. Bhuiyan and Irabagon (1992) also obtained larger and heavier fruits due to the effects of fertilization. The treatment 150% of fertilizer dose manifested the highest edible portion (66.36 %) as against the lowest edible portion in control plants (59.48 %). Plants received 150% of fertilizer dose in three installments gained the highest edible portion (68.27 %) as compared to the lowest edible portion (59.14 %) in control. The stone pulp ratio varied from 0.25 to 0.35 showing the minimum in plants treated with 150% of fertilizer dose and maximum in control plants. Fertilizer applying in three installments resulted in the least stone pulp ratio (0.27). It ranged from 0.22 to 0.36 having the minimum stone pulp ratio in 150% of fertilizer dose combined with three installments and the maximum value in control. The peel pulp ratio ranged from 0.24 to 0.31 being the lowest value in 100% of fertilizer dose and the highest ratio in control. It ranged from 0.25 to 0.29 showing the minimum in A_3 and maximum in A_1. The treatment combination 100% of fertilizer dose and three installments of application exhibited the lowest peel pulp ratio (0.23) as compared to the highest value in control (0.32). All the treatment combinations showed higher shelf life except control the least. Higher values of shelf life were recorded in T_1 (8.97 days), T_2 (8.86 days) and T_3 (8.72 days) treatments, but it was reduced and found to be the lowest (7.06 days) in control plants. Among the treatment combinations, 100% of fertilizer dose and two installments of application had higher (9.50 days) shelf-life as against the lowest shelf life (6.33 days) in the control.

Effects on TSS, pH and titratable acidity of mango

Variation in terms of TSS, pH and titratable acidity was found due to different fertilizer doses (Table 1). Installment of fertilizer application demonstrated insignificant variation in respect of pH and titratable acidity, whereas TSS showed significant variation (Table 2). The result indicated the significant combined effect of fertilizer doses and installment of application on TSS and titratable acidity, where pH noted insignificant variation (Table 3). The treatment 150% of fertilizer dose attained a maximum TSS of 24.65 per cent closely followed by 100% of fertilizer dose (23.91%) while the control treatment attained the minimum to the extent of 21.92 per cent. TSS varied from 22.75 to 24.13%, the highest being in three installments and the lowest value in one installment of application. The combination of 150% of fertilizer dose and three installments had maximum (26.32%) TSS which was statistically at par to that of 100% of fertilizer dose combined with three installments of application (24.86%). The

control exhibited the minimum (21.71%) TSS. The highest TSS content at 150% of the fertilizer dose in the current study is close to similar with the findings of Suriyapananont and Subhadrabandhu (1992), who reported the highest TSS content with the use of 1.0 kg N, 0.2 kg P, and 1.5 kg K/tree. The pH ranged from 5.70 to 5.86 being the minimum in control and maximum in the treatment 150% of the fertilizer dose. The treatment 150% of fertilizer dose recorded the minimum titratable acidity (0.20), whereas the control plants recorded the highest titratable acidity (0.25). Plants received 150% of fertilizer dose in three installments exhibited the lowest titratable acidity (0.19) closely followed by T_3A_2 and T_3A_1, T_2A_3 as compared to control (0.25).

Effect on vitamin C of mango

Significant variation in terms of vitamin C was observed due to fertilizer doses (Table 1), but installment of fertilizer application would not create significant impact on vitamin C (Table 2). The combined effect of fertilizer doses and installment of application on vitamin C content was significant (Table 3). The plants treated with 150% of fertilizer dose recorded maximum vitamin C content (30.18 mg/100g pulp), which was followed by 100% of fertilizer dose with 29.03 mg/100g pulp as against minimum vitamin C content (27.71 mg/100g pulp) in control plants. The combination of 150% of fertilizer dose and three installments resulted in the highest vitamin C content (30.59 mg/100g pulp), while it was found the lowest in control plants (27.68 mg/100g pulp).

Effects on moisture content and dry matter content of mango

There were significant variations in terms of moisture content and dry matter content as influenced by different fertilizer doses and the combined effect with installment of application (Table 1 and 3). The single impact of installment of fertilizer application on moisture and dry matter content was not significant (Table 2). The lowest moisture content (78.81%) was observed in the plants treated with 150% of fertilizer dose followed by 100% of fertilizer dose (79.57%) as against the highest content (81.33%) in the control plants. The plants when fertilized with 150% of dose in three installments resulted in minimum (78.35%) moisture content and the control had maximum content (81.44%). The mango fruits contained the highest dry matter content (21.19%), when 150% of fertilizer dose were applied which was statistically identical to that of 100% of fertilizer dose (20.43%). The untreated control plants resulted in the lowest (18.67%) dry matter content. The plants fertilized with 150% of the dose following three installments registered the highest dry matter content (21.65%) compared to control (18.56%).

Table 4. Influence of fertilizer on quality of mango.

Fertilizer dose	TSS (%)	pH	Titra-table acidity (%)	Vitamin C (mg/100 g pulp)	Moisture content (%)	Dry matter content (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
50% of fertilizer dose	22.77	5.80	0.23	28.61	80.35	19.65	4.82	13.04	17.87
100% of fertilizer dose	23.91	5.85	0.22	29.03	79.57	20.43	4.89	13.22	18.11
150% of fertilizer dose	24.65	5.86	0.20	30.18	78.81	21.19	4.98	13.48	18.46
Control	21.92	5.70	0.25	27.71	81.33	18.67	4.78	12.93	17.71
CV%	5.53	2.05	6.46	3.47	1.08	4.31	2.60	2.55	2.46
LSD (0.05)	1.26	0.11	0.01	0.98	0.84	0.84	0.12	0.33	0.43

Table 5. Influence of installment of fertilizer application on quality of mango.

Installment of application	TSS (%)	pH	Titra-table acidity (%)	Vitamin C (mg/100 g pulp)	Moisture content (%)	Dry matter content (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
One installment	22.75	5.81	0.23	28.81	80.36	19.64	4.84	13.09	17.93
Two installments	23.05	5.80	0.22	28.62	79.99	20.01	4.87	13.17	18.04
Three installments	24.13	5.79	0.21	29.22	79.69	20.31	4.90	13.24	18.14
CV%	5.53	2.05	6.46	3.47	1.08	4.31	2.60	2.55	2.46
LSD (0.05)	1.09	-	-	-	-	-	-	-	-

Table 6. Combined effect of fertilizer and its installment of application on quality of mango.

Fertilizer dose	Installment of application	TSS (%)	pH	Titra-table acidity (%)	Vitamin C (mg/100 g pulp)	Moisture content (%)	Dry matter content (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
50% of fertilizer dose	One installment	22.33	5.80	0.24	28.50	80.58	19.42	4.81	13.00	17.81
	Two installments	22.84	5.80	0.23	28.55	80.35	19.65	4.83	13.04	17.87
	Three installments	23.13	5.79	0.23	28.78	80.13	19.87	4.84	13.08	17.92
100% of fertilizer dose	One installment	23.33	5.88	0.23	29.10	79.93	20.07	4.85	13.13	17.98
	Two installments	23.53	5.84	0.22	28.25	79.65	20.35	4.90	13.24	18.14
	Three installments	24.86	5.82	0.20	29.74	79.12	20.88	4.92	13.29	18.21
150% of fertilizer dose	One installment	23.64	5.89	0.21	29.96	79.49	20.51	4.94	13.35	18.29
	Two installments	24.00	5.86	0.20	29.98	78.58	21.42	4.96	13.45	18.41
	Three installments	26.32	5.84	0.19	30.59	78.35	21.65	5.04	13.64	18.68
Control	One installment	21.71	5.69	0.25	27.69	81.44	18.56	4.76	12.89	17.65
	Two installments	21.83	5.71	0.25	27.68	81.39	18.61	4.78	12.94	17.72
	Three installments	22.22	5.70	0.25	27.76	81.17	18.83	4.79	12.95	17.75
CV(%)		5.53	2.05	6.46	3.47	1.08	4.31	2.60	2.55	2.46
LSD (0.05)		2.18	-	0.02	1.70	1.45	1.45	-	-	0.75

Effects on reducing sugar, non-reducing sugar and total sugar content of mango
Fertilizer doses exhibited significant differences with regard to reducing sugar, non-reducing sugar and total sugar content (Table 1). Installment of fertilizer application resulted in insignificant variation in respect of all above characters (Table 2). Variation due to the combined effect in terms of reducing sugar, non-reducing was found insignificant except total sugar which was noted to be significant (Table 3). The reducing sugar content ranged from 4.78 to 4.98%

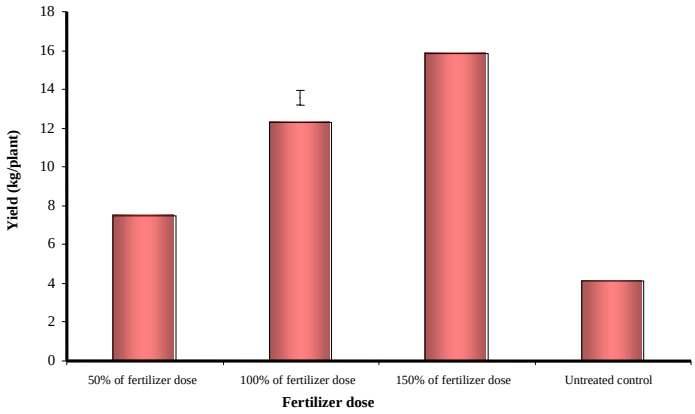

Fig. 1. Effect of fertilizer dose on the yield per plant of mango. Vertical bar represents LSD at 5% level

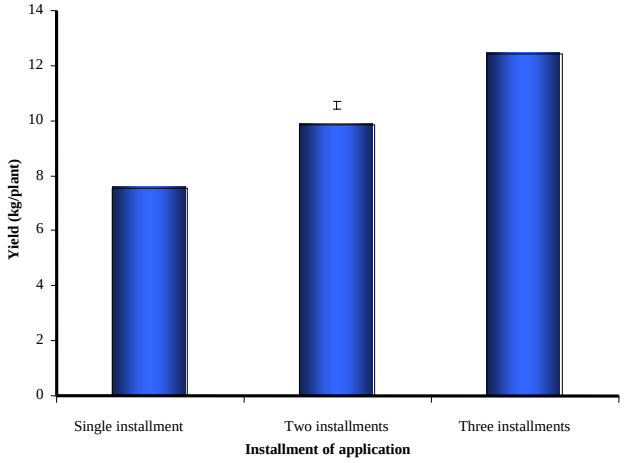

Fig. 2. Effect of installment of fertilizer application on the yield per plant of mango. Vertical bar represents LSD at 5% level

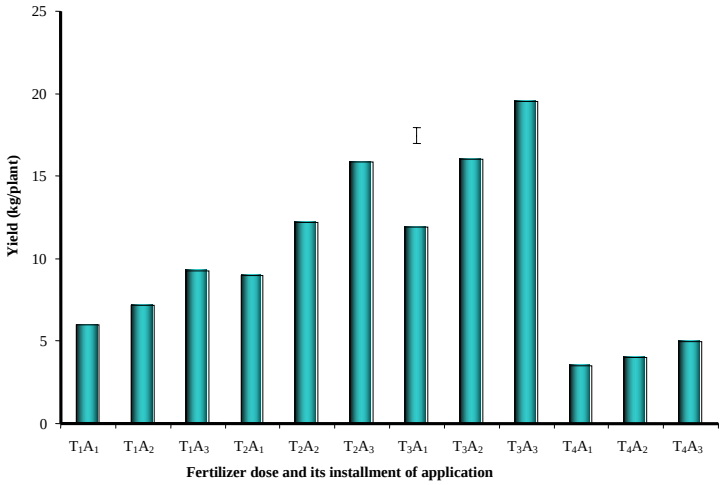

Fig. 3. Combined effect of fertilizer dose and its installment of application on the yield per plant of mango. Vertical bar represents LSD at 5% level

T_1 : 50% of fertilizer dose (Cow dung $_{12.5\ kg}$, Urea $_{375\ g}$, TSP_{200g}, $MP_{125\ g}$, Gypsum $_{125\ g}$ and Zinc Sulphate $_{7.5\ g}$ per plant)
T_2 : 100% of fertilizer dose (Cow dung $_{25\ kg}$, Urea $_{750g}$, TSP $_{400g}$, MP $_{250g}$, Gypsum $_{250\ g}$ and Zinc Sulphate $_{15\ g}$ per plant)
T_3 : 150% of fertilizer dose (Cow dung $_{37.5\ kg}$, Urea $_{1125g}$, TSP $_{600g}$, MP $_{375\ g}$, Gypsum $_{375\ g}$ and Zinc Sulphate $_{22.5\ g}$)
T_4 : Control
A_1 : One installment A_2 : Two installments A_3 : Three installments

being the lowest content in control and the highest content in 150% of fertilizer dose (T_3). The plants when fertilized with 150% of the dose resulted in the maximum non-reducing sugar content (13.48%), which was followed by 100% of the fertilizer dose (13.22%) as compared to the lowest content in control (12.93%). The treatment 150% of fertilizer dose exhibited the highest total sugar (18.46%) which was statistically at par to that of 100% of fertilizer dose (18.11%), whereas the control plants recorded the least content (17.71%). Applying fertilizer to the plants at 150% of the dose in three installments demonstrated the maximum total sugar content (18.68%) as compared to the minimum content (17.65%) in control. Application of 100 g each of N, P, and K per mango plant cv. Amrapali per year in West Bengal, India, markedly increased the number of fruits/plant, yield, pulp content and also improved the fruit quality (Satapathy and Banik, 2002). The improved performances due to the highest dose of muriate of potash along with other manures and fertilizers applied in three splits in the current study are close to the findings of Fouad *et al.* (2003), where increasing K fertilizer rate and the number of applications increased the

leaf area, shoot length, fruit retention, yield, fruit weight and size, total soluble solid content, total sugar content, and ascorbic acid content, but reduced fibre percentage, and total acidity of mango cv. Mabrouka at West Samalout, Minia Governorate, Egypt.

Conclusion

Fertilizer at the rate of cowdung 37.5 kg, urea 1125 g, TSP 600 g, MoP 375 g, gypsum 375 g, and zinc sulphate 22.5 g per mango plant may be applied in three installments (preferably in September, March and May) in order to get superior yield and quality of fruits.

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