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Effect Of Different Sources Of Nutrients And Time Of Irrigation On The Fruiting Behavior And Yield Of Mango

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Abstract
An experiment was conducted at the Germplasm Centre (GPC) of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from February to July 2022 to study the effect of different sources of nutrients and time of irrigation on the fruiting behavior and yield of mango (cv).Amrapali).The study consisted of two factors: Factor A- different sources of nutrients viz.(i) fertilization during the experimental period (control), (ii) NPK fertilizations, (iii) poultry manure (iv) Decomposed cowdung and (v) Compost; Factor B-time of irrigation, viz.(i) on irrigation during the experimental period, (ii) irrigation at 7 days interval after fertilization ,(iii) irrigation at 14 days interval after fertilization (iv) irrigation at 21 days interval after fertilization .The experiment was laid out in Split Plot Design (SPD) with three replications .Almost all the parameters studied were found to be influenced by different sources of nutrients and time of irrigation. Number of inflorescences per plant, number of fruits set per plant (at pea stage), total number of fresh fruits , fruit length ,fruit diameter, individual fruit weight, percent total number of fresh fruit, percent cracking , percent dropping, total soluble solids (TSS) and yield per plant were found superior in NPK applied plant except number of fruits drop, number of fruits crack per plant, percent fruits drop, percent fruit crack per plant. All the stated above parameters were also obtained from irrigation at 7 days interval than that of irrigation at 14 and 21 days interval .The combined effect of different sources of nutrients and time of irrigation revealed significant variation in fruiting behavior and yield . Treatment combination of NPK fertilizer and time of irrigation at 7 days interval produced the highest yield .The lowest fruiting behavior and yield was found in control treatments in case of main and combined effect .NPK fertilizer and 7 days interval irrigation application during flowering period is suggested to obtain higher yield in mango.

Key word: *Sources of Nutrients, Irrigation, Fruiting Behavior, Yield and Mango*

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I. Introduction

Mango *(Mangifera indica* L.) is one of the most popular and commercially important fruit in Bangladesh and is called as the `King of fruit`. It belongs to the family Anacardiaceae. It has been cultivated in this sub-continent from four thousand years ago (Candole,1984).The fruit is believed to have originated in the Eastern India Asam, Burma or in the Malayan region (Mukherjee,1997; El-Wakeel, 2005; Bhatt, 2009).The production of mango is greatly influenced by different fertilizer and irrigation along with other management practices .Fertilization is one of the most important intercultural operations that affect directly to the yield of mango .For getting optimum yield, the plants are required optimum nutrition after blossoming .If fertilization is not done right time then yield is reduced as because fertilization few days before blossoming or during blossoming may lead to new vegetative growth reducing the flowering of mango and consequently the yield of mango .The number of fruits and quality of fruits enhance due to the fertilizer application after flowering. On the other hand ,mango does not need irrigational water throughout the year but when it does, fairly irrigation must be provided (Singh,1968).The time of irrigation is ,therefore ,very important for maximization of yield. In case of bearing trees of mango, it is necessary to have a dry condition for 3 months after rainy season or to flowering to get satisfactory bearing (Hossain,1994). It is believed that irrigation from the to me of fruit set till the monsoon tends to prevent fruit drop and helps to improve in size and quality of the fruit (Singh, 1968). Proper fertilizers and flood irrigation helps in retention of maximum fruits at bearing stage (Santos, 2007). Application of water is recommended soon after emergence of inflorescence, at fruit set and thereafter at 15 days interval (Hossain and Habib, 2001; Gaya, 2008). Research works related to the effect of different sources of nutrients and irrigation on the fruiting behavior and yield of mango are very much limited in Bangladesh. Therefore, it was thought necessary to investigate the effects of different source of nutrients and time of irrigation on yield component and yield of mango. Keeping the above stated in mind the present piece of study

was undertaken with the following objectives: i) to increase the flowering and fruition in mango by applying different fertilization and irrigation; and ii) to increase the yield of quality mango per unit area.

II. Materials and Methods

The present study was carried out at the `Germplasm Centre` (GPC) of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from February to July 2022. The experiment was conducted with the mango variety "Amrapali". The plants were previously planted and the age of plant was seven years. The study consisted of two factors: Factors-A: Different sources of nutrients: i) No fertilization during the experimental period (M_0); ii) NPK (Urea-500g; TSP-110g and MoP-166g per plant) (M_1); iii) Poultry manure(20Kg/plant) (M_2); iv) well decomposed cowdung(25 Kg/plant) (M_3) and v) compost(30Kg/plant) (M_4) Factor –B :Time of irrigation**:** i) No irrigation applied during the experimental period (I); ii) Irrigation applied at 7 days interval (I_1) on 21.02.2022; iii) Irrigation applied at 14 days interval (1_2) on 28.02.2022 and iv) Irrigation applied at 21 days interval (I_3) on 06.03,2022. The two –factor experiment was laid out in a Split plot Design (SPD) with 3 replications .The whole experiment area was divided into 3 blocks .Each block was again divided into 5 main plots and each main plot was again subdivided into 4 subplots. There were all together 60 unit plots. Total manure and fertilizers application was done just after flowering at February 14, 2022 and irrigation was done just after manure and fertilizer application. The irrigation treatments assigned to the main plots in order of level of irrigation and fertilizer treatments were assigned randomly to the subplots. The experimental area was kept the orchard free from weed and to pulverize the soil. To control insects and diseases insecticides and fungicides were applied at regular interval. Harvesting was done depending on the maturity of the mango from June 15 to 25, 2022. Data were recorded on the number of inflorescence per plant, number of fruits set per plant, total number of fresh fruits per plant, number of fruits dropped at different stage per plant, number of cracked fruits per plant, fruit length at harvest, fruit diameter at harvest, individual fruit weight, percent total number of fresh fruits per plant, percent fruits cracked per plant, percent fruit dropped per plant, total soluble solid(% Brix), and yield (Kg/plant). The data obtained from the experiment on various parameters were statistically analyzed to find out significance of the difference among the different treatment combinations and were evaluated by Analysis of Variance Method (ANOVA).The mean separation was done by LSD as described by Gomez and Gomez (1984).

III. Results and Discussion

The experiment was conducted to study the effect of different sources of nutrients and irrigation on the fruiting behavior and yield of mango cv. Amrapali.

Main effect of different sources of nutrients on the fruiting behavior and yield of mango

Different sources of nutrients exhibited a significant influence on the production of number of inflorescences per plant, number of fruits set per plant, total number of fresh fruits per plant, number of fruits dropped at different stage per plant, number of cracked fruits per plant, fruit length at harvest, fruit diameter at harvest, individual fruit weight, total soluble solid(% Brix), percent total number of fresh fruits per plant and yield (Kg/plant).The highest number of inflorescences (163.21) per plant were found in poultry manure fertilized plant that was applied during flowering period. The lowest number of inflorescences (138.95) was produced in NPK applied plants. The highest number of fruits set (219.88) per plant, total number of fresh fruit(133.37) per plant, fruit length (8.74cm), fruit diameter (5.98cm), individual fruit weight (286.59gm), total soluble solid(24.77 % Brix), percent total number of fresh fruits per plant (69.68%) and yield (38.39 Kg) were observed from the NPK applied plant. The lowest values were found on all the mentioned parameters in no fertilized plants. The maximum number of fruits dropped (75.28) per plant, fruits cracked (27.58) per plant, percent fruits cracked (23.46%) per plant and percent fruits dropped (47.48%) per plant were found from no fertilized plants and the lowest values were found from the NPK applied plants. The highest yield was produced in the stated treatment was due to supply of required nutrition during the growth and development of young fruits (Binepal and Tiwari 2018). Similar results are in agreement with Banik (1997) and Sing (2000). Availan and Figueroa (1977) reported that the highest yield was obtained by applying nitrogen, P2O5 and K2O at 80:30:30 kg per hectare applied to mature kent, smith and zill varieties at flowering stage.

Table 1. Main effect of different sources of nutrients on the fruiting behavior and yield of mango

Treatment Different sources of nutrients	Number o f inflorescences per plant	Number of fruits set (at pea stage)per plant	Total number of fresh fruits per plant	Number of fruits dropped per plant	Number of fruits cracked per plant	Fruit length (cm)	Fruit diameter (cm)
Mo	150.21	118.88	38.29	75.28	27.58	5.49	3.99
M_1	138.95	219.88	133.37	65.26	15.99	8.74	5.98
M_2	163.21	155.57	102.12	58.88	15.85	7.43	4.98

M_3	151.19	181.55	82.33	65.97	15.24	7.74	5.74
M_4	149.25	147.24	65.13	55.95	17.74	6.69	5.28
LSD (0.05)	4.49	4.25	3.14	3.77	0.78	0.54	0.29
LSD(0.01)	12.75	6.78	5.44	5.78	0.79	0.56	0.49

Table 1.Cont' d

Treatment Different sources of nutrients	Individual fruit weight	Total soluble solids (%)	%Total number of fruits per plant	%Fruits cracked per plant	% Fruits dropped per plant	Yield (Kg/plant)
M_0	218.89	24.34	45.23	23.46	47.48	25.22
M_1	286.59	24.77	69.68	7.49	35.67	38.39
M_2	255.37	23.77	54.89	12.55	38.28	34.39
M_3	244.87	2325	60.78	8.89	35.58	31.39
M_4	245.98	23.74	51.38	12.98	39.36	30.39
LSD (0.05)	12.77	0.07	1.55	0.58	1.88	2.23
LSD (0.01)	15.57	0.08	2.69	0.89	2.89	3.25

M_0= No fertilization during the experimental period (control);M_1 =NPK ;M_2 = poultry manure ;M_3 = well decomposed cowdung and M_4 = Compost

Main effect of irrigation on the fruiting behavior and yield of mango

The application of irrigation also showed the significant effect on all the mentioned parameters. The highest number of inflorescences (172.20) per plant, number of fruits set per plant (205.87), total number of fresh fruits (119.80) per plant, fruit length at harvest(7.98), fruit diameter at harvest (5.96) , percent total number of fresh fruit(60.46%) per plant individual fruit weight (269.46g), total soluble solid(% Brix 23.69%), and yield (31.94 Kg/plant)were found in case of irrigation at 7 days interval, The maximum number of fruits dropped (68.89) at different stage per plant, number of cracked fruits per plant (22.78), percent fruits dropped (45.46%) per plant, percent fruits cracked per plant (18.29%) and the lowest values were found on all the stated parameters in no irrigation plant. It might be due to the favorable climatic condition and influence of soil moisture supplied through artificial water that ensures better availability of plant nutrients (Kumari,*et al.*,2023). Sigh (1968) also noticed that irrigation at this stage also increased the fruit set. Again, Hossain (1989) agreed with this result and stated that after application of fertilizers a plant must be irrigation so that the soil around it remain to sufficiently wet. Wagner *et al.*(1984) reported that trees irrigated to field capacity at 7 days intervals from March to May produced higher yields (287.53 Kg/plant) than trees irrigated at 14 or 21 day intervals (177.45 and 96.25 Kg/plant, respectively).The highest yield in stated treatment was produced as because use of fertilizer by reaching to the root zone of plant (Malhotra, 2017;Rao *et al.*,2022 and Malshe, et al., 2020).

Table 2.Main effect of irrigation on the fruiting behavior and yield of mango

Treatment Different sources of nutrients	Number of inflorescences per plant	Number of fruits of set (at pea stage) per plant	Total number of fresh fruits per plant	Number of fruits dropped per plant	Number of fruits cracked per plant	Fruit length (cm)	Fruit diameter (cm)
1_o	150.60	129.47	80.11	56.78	22.78	6.78	4.95
1_1	172.20	205.87	119.80	68.89	17.89	7.98	5.96
1_2	151.88	176.87	94.67	65.98	18.59	7.25	5.87
1_3	141.54	151.78	82.89	59.47	19.98	6.98	4.89
LSD (0.05)	3.98	3.87	2.13	3.78	1.57	0.19	o.27
LSD (0.01)	5.87	5.47	3.44	4.87	2.87	0.29	o.34

Table 2. cont'd

Treatment Different of nutrients	Individual fruit weight (g)	Total soluble solids (%)	%Total number of fresh fruits per plant	% Fruits cracked per plant	% Fruits dropped per plant	Yield (Kg/plant)
1_0	215.70	23.52	41.48	18.29	45.46	11.07
1_1	269.46	23.69	60.48	9.82	35.53	31.94
1_2	266.87	23.61	55.27	11.90	37.73	25.27
1_3	258.28	23.42	51.24	13.45	39.13	18.23
LSD(0.05)	10.98	1.66	2.29	0.68	2.19	2.32
LSD (0.01)	14.88	2.87	3.79	0.80	2.89	3.42

1_0 = No Irrigation applied during the experimental period (control);1_1 = Irrigation at 7 days interval;1_2 = Irrigation at 7 days interval and 1_3= Irrigation at 21 days interval

The combined effect of different sources of nutrients and irrigation on the fruiting behavior and yield of mango.

The combined effect of different sources of nutrients and irrigation was significant on the production of number of inflorescences per plant.

The highest number of inflorescences (187.33) per plant, number of fruits set per plant (196.06), total number of fresh fruits (181.27) per plant, fruit length at harvest(7.98), fruit diameter at harvest(5.96) , individual fruit weight (309.24g), total soluble solid (% Brix 24.69%), and yield (55.94Kg/plant) were found from the NPK applied plant where 7 days interval irrigation was applied. The maximum number of fruits dropped (65.08) at different stage per plant, number of cracked fruits (22.78) per plant, percent fruit dropped (53.08%) per plant and percent fruit cracked (26.99%) plant as well as the lowest values were recorded on all the stated parameters in no fertilizer and no irrigation applied plant. The highest yield was in the said combination due to availability of nutrition at right time i.e. during fruit growth and development and the lowest yield was produced due to lack of proper nutrients availability and soil moisture (Samra, 2010).

Table 3. Combined effect of different sources of nutrients and irrigation on the fruiting behavior and yield of mango

Treatment Different sources of nutrients	Number of inflorescences Per plant	Number of fruits set (at pea stage)per plant	Total number of fresh fruits per plant	Number of fruits dropped per plant	Number of fruits cracked per plant	Fruit length (cm)	Fruit diameter (cm)
M_0I_0	157.00	95.47	44.22	48.33	27	4.90	3.55
M_0I_1	175.00	139.54	45.25	62.03	25	5.44	3.69
M_0I_2	142.33	117.00	52.25	54.05	24	5.90	3.89
M_0I_3	143.00	107.14	57.78	49.45	25	5.50	3.99
$M11_0$	118.00	169.12	56.84	69.69	18	7.43	4.89
M_0I_1	169.00	272.45	58.64	79.78	12	9.33	6.59
M_0I_2	154.33	239.39	61.25	77.69	13	8.93	6.29
M_0I_3	129.33	195.35	66.86	67.67	13	8.69	5.69
M_2I_0	159.33	85.69	75.62	37.69	14	6.99	4.49
M_2I_1	187.33	196.06	181.27	65.08	13	7.69	4.98
M_2I_2	155.67	179.09	98.25	67.69	15	7.55	4.88
M_2I_3	149.67	149.69	178.54	59.09	27	6.88	4.59
M_3I_0	147.67	162.69	58.96	67.69	17	7.53	4.99
M_3I_1	149.67	212.66	94.25	65.69	12	7.80	6.97
M_3I_2	169.00	182.66	102.36	58.69	14	7.80	5.55
M_3I_3	138.33	168.69	122.54	58.69	15	7.52	4.89
M_4I_0	159.00	126.06	145.56	55.50	21	6.58	4.28
M_4I_1	173.33	179.09	165.44	59.06	15	7.59	5.54
M_4I_2	127.67	149.39	87.99	59.09	16	6.57	5.84
M_4I_3	135.33	129.09	95.87	49.09	18	6.57	5.22
LSD (o.o5)	2.89	3.69	5.45	2.88	0.89	0.19	0.19
LSD (0.01)	4.89	4.88	7.89	3.66	1.45	0.27	0.29

Table 3.(Cont'd)

Treatment Different sources of nutrients	Individual fruit weight (g)	Total soluble soluds(%)	%Total number of fruits per plant	%Fruits cracked per plant	%Fruits dropped per plant	Yield (Kg/plant)
M_0I_0	191.14	26.56	21.33	26.99	53.08	13.7
M_0I_1	199.79	26.13	40.12	16023	44.37	15.12
M_0I_2	217.49	26.66	35.23	20.36	46.69	16.23
M_0I_3	237.09	26.59	31.67	22.79	45.88	14.14
M_0I_0	225.19	24.18	50.23	9.39	40.83	12.45
M_1I_1	309.24	24.27	67.32	4.69	29.80	55.94
M_1I_2	294.75	24.17	62.67	5.09	31.88	17.21
M_1I_3	284.96	23.58	59.23	6.69	33.88	21.21
M_2I_0	209.36	25.17	39.67	17.68	42.70	23.25
M_2I_1	264.96	24.77	61.33	6.09	32.70	26.25
M_2I_2	259.36	24.68	55.12	7.69	36.78	27.29
M_2I_3	255.49	24.68	51.33	10.69	37.78	28.23
M_3I_0	219.38	24.18	47.45	11.90	41.73	29.21
M_3I_1	278.39	24.19	64.23	5.90	30.78	28.78

M_3I_2	267.38	24.48	63.23	7.90	31.78	29.23
M_3I_3	259.89	24.27	57.23	8.39	34.73	33.26
M_4I_0	192.28	24.98	41.38	16.78	41.78	12.21
M_4I_1	254.78	24.89	59.69	7.39	32.78	42.12
M_4I_2	254.25	24.97	50.39	10.70	39.70	41.15
M_4I_3	251.96	24.17	46.56	13.69	39.73	43.23
LSD (0.05)	7.88	0.17	1.95	0.49	1.49	3.45
LSD (0.01)	12.29	0.26	2.39	0.89	2.48	5.47

M_0 =No fertilization during the experimental period (control)
M_1 =NPK
M_2 =poultry manure
M_3 =well decomposed cowdung
M_4 = Compost

I_o =No Irrigation applied during the experimental period (control)
I_1 =Irrigation at 7 days interval
I_2=Irrigation at 14 days interval
I_3 =Irrigation at 21 days interval

IV. SUMMARY

The present study was carried out at the `Germplasm Centre` (GPC) of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from February to July 2022. The experiment was conducted with the mango variety "Amrapali". The plants were previously planted and the age of plant was seven years. The study consisted of two factors: Factors-A: Different sources of nutrients: i) No fertilization during the experimental period (M_0); ii) NPK (Urea-500g; TSP-110g and MoP-166g per plant) (M_1); iii) Poultry manure(20Kg/plant) (M_2); iv) well decomposed cowdung(25 Kg/plant) (M_3) and v) compost(30Kg/plant) (M_4) Factor –B :Time of irrigation**:** i) No irrigation applied during the experimental period (I); ii) Irrigation applied at 7 days interval (I_1) on 21.02.2022; iii) Irrigation applied at 14 days interval (1_2) on 28.02.2022 and iv) Irrigation applied at 21 days interval (I_3) on 06.03,2022. The two –factor experiment was laid out in a Split plot Design (SPD) with 3 replications .The whole experiment area was divided into 3 blocks .Each block was again divided into 5 main plots and each main plot was again subdivided into 4 subplots. There were all together 60 unit plots. Total manure and fertilizers application was done just after flowering at February 14, 2022 and irrigation was done just after manure and fertilizer application. Intercultural operation were done as and when necessary.

Different sources of nutrients showed significant influence on all the parameters .The maximum number of fruits set (at pea stage)per plant ,number of fruits dropped per plant, number of fruits cracked per plants ,length of fruits ,diameter of fruits ,total number of fresh fruits per plant , percentage of total number of fresh fruits per plant and total soluble solids (TSS) were obtained from NPK treatments ,while lowest values of all the above mentioned parameters were found in control treated plants except number of inflorescence per plant .The highest percentage of fruit dropped and cracked per plant were found in control plants while the lowest values were found in NPK treated plants. When yield was considered, NPK treated plants produced the highest (38.39kg/plant) yield while the lowest (25.22 kg/plant) was obtained from control plants.

Irrigation at different days interval had significant influence on all the parameters .The maximum number of inflorescence per plant ,number of fruit set (at pea stage)per plant ,number of fruit dropped per plant ,number of fruits cracked per plant ,length of fruits ,diameter of fruits ,total number of fresh fruits per plant ,percentage of total number of fresh fruits per plant and total soluble solids (TSS)were obtained from irrigation at 7 days interval, while the lowest values of all the above mentioned parameters were found in on irrigated plants .The highest percentage of fruit dropped and fruit cracked per plant were found in control plants while the lowest values were found in 7 days interval irrigated plants. When yield was considered, Irrigation at 7 days interval treated plants produced the maximum yield (31.94 Kg/plant) while the lowest yield (11.07 Kg/plant) was obtained from control plant. Combined effect of different sources of nutrients and irrigation exhibited mark influence on all the parameters studied .the maximum values of all the characters were obtained from the treatment combination of NPK treated with 7 days interval irrigated plant. NPK fertilization with 7 days interval irrigated plants gave the highest (55.74 kg) yield and the lowest (3.77 kg) yield was found from no fertilized and irrigated plants.

V. Conclusion

NPK fertilization and 7 days interval irrigated plants produced the maximum yield showing the best performance in respect of all the yield and yield attributes. Both fertilization and irrigation was likely to promote proper growth ,development and retention of young fruit leading to better yield of mango before fruit setting period .

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