Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 1380-1383
Received: 18-09-2019
Accepted: 20-10-2019

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Effect of organic, inorganic and biofertilizers on yield and economics of Mango cv. Amrapali

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Abstract
The experiment was carried out at Horticultural Research Farm, Department of fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during 2015-16 to find out the effect of organic, inorganic and biofertilizers on yield and economics of mango cv. Amrapali. Result indicated that maximum number of fruits per plant (140.33), maximum fruit weight (212.00 g), maximum fruit yield per plant (29.60 kg) and fruit yield per hectare (11.84 tones). The highest gross and net monetary returns per hectare (Rs. 236800 and Rs. 167646.86) were also obtained in the treatment T_2 (80% RDF + Cowdung slurry @10lit/tree).

Keywords: Organic, inorganic, biofertilizer, Amrapali, net return

1. Introduction
The mango (*Mangifera indica* L.) belongs to family "Anacardiaceae" is one of the most important fruit crops of the country and originated in South-East Asia at an early date. It is the premier and choicest fruit of India and undoubtedly one of the best fruit of the world. Mango is being grown in more than 87 countries of the world and India ranks first in the world with respect to 1.60 million hectares area and 10.78 million tonnes production. India contributes to more than 70 per cent of the total worlds production and this offers bright prospect for furthers boosting exports. It is called 'the King of fruits', 'heavenly fruit' and 'super fruit', due to its sweetness potential health values, excellent flavour, attractive appearance and popularity among the masses. Chhattisgarh is one of the important mango growing state of India and occupies 2163.47 thousand hectares area with production of 18526.98 million tonnes and a productivity of 5.25 metric tonnes ha^{-1} (Anon., 2015) [1]. Most of the area of Chhattisgarh is rainfed and vast acreage has an immense potential to improve mango production. Mango is grown in all the districts of Chhattisgarh, but the maximum acreage is in Raipur, Bastar, Durg and Rajnandgaon (Shrivastava, 1987) [14].
Nutrition of trees is an important part of mango orchard management practices and fertilizer is one of the major inputs accounting for nearly 35 percent of the cost of cultivation. Indiscriminate use of inorganic chemical fertilizers resulted in high amount of chemical residues in field as well as in the crop produces leading to various environmental and heat hazards along with socio-economic problem (Kundu *et al*., 2011) [8]. In order to maintain soil health and to obtain yield of better quality fruits, it is essential to adopt integrated nutrient management (INM) approach. Integrated nutrient management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Application of plant growth regulators also enhance flowering, fruiting, quality and economic of fruits (Lal *et al*., 2013 and Lal and Das, 2017) [10, 9]. Therefore, it is a holistic approach where we first know what exactly is required by plants for optimum level of production, in what different forms at what different timings in best possible method, and how best these forms can be integrated to obtain highest productivity levels with efficiency at economically acceptable limits in environmental friendly way. Biofertilizers are the living organism which add, conserve and mobilize the plant nutrients in the soil. The beneficial effect of bio-fertilizers is now well established in fruit crops like mango (Kundu *et al.,* 2011) [8], papaya (Sukhade *et al.,* 1995) [17] and banana (Gogoi *et al.,* 2004) [7]. Therefore, an experiment was conducted on effect of organic, inorganic and biofertilizers on Yield and economics of Mango cv. Amrapali.

2. Materials and Methods
The experiment was carried out at Horticulture Research Farm Department of fruit science, of Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh 2015-16 to find out the effect of

organic, inorganic and biofertilizers on 15 year old mango cv. Amrapali which were planted at 5m x 5m spacing. The research station is located at latitude 21.16 °N and Longitude 81.36 °E at an altitude of 289.56 metres above the mean sea level. The experiment was laid out with ten treatments and three replications with randomized block design. Three levels of inorganic fertilizers (100% NPK, 80% NPK and 60% NPK) were applied alone and also in combinations with different organic and biofertilizers *viz*. Cowdung slurry, Vermiwash, Azospirillum C.G. Trychome and PSB. The plant fertilized with 100% NPK revealed 500g nitrogen, 300g phosphorus and 500g potassium. Nitrogen fertilizer was applied in three split doses. First dose of Nitrogen was applied on 20th January, before flowering, while the second dose of Nitogen was applied on 20th March, after flowering and third dose of Nitrogen was applied on 20th April after the fruit setting. Phosphorus and Potash were applied in a single application before flowering on the 20th December. The fertilizers used a source of Nitrogen, Phosphorus and Potassium were Urea, Single super phosphate and Potassium Sulphate respectively. Biofertilizers@100g each was incorporated to the concerned plant and organic fertilizers@10lit/tree. Organic, inorganic and biofertilizers were applied in a ring 1 meter away from the trunk and at a depth of 30 cm. Fruit weight (g), number of fruits per plant and yield were recorded, and economics of different treatments were calculated.

Table 1: Treatment details

Notation	Details
T_0	Control (Without nutrient application)
T_1	100% RDF (500:300:500 gm NPK/tree)
T_2	80% RDF+ Cowdung slurry @10lit/tree
T_3	80% RDF + Vermiwash @10lit/tree
T_4	80% RDF + C.G Trychome (100g/tree)
T_5	80% RDF + Azospirillum +PSB (100+100 gm/tree)
T_6	60% RDF + Cow dung slurry @10lit/tree
T_7	60% RDF + Vermiwash @10lit/tree
T_8	60% RDF + C.G Trychome **(**100g/tree)
T_9	60% RDF + Azospirillum + PSB (100+100 gm/tree)

3. Results and Discussions

3.1 Number of fruits per plant

The maximum number of fruits per plant (140.33) was recorded with treatment 80% RDF + Cow dung slurry@10 lit/tree (T_2) fallowed by 100% RDF (T_1) whereas minimum number of fruits per plant (85.66) was recorded under the treatment T_0 (Control). The treatment T_3 and T_6, T_4 and T_5 were found statistically at par. The production of more number of fruits in the treatments of combined application of inorganic fertilizers with cow dung slurry at different levels could be a result of the improvement in soil physical, biological and chemical properties which in turn, provided required nutrition for the conversion of flowers to fruits resulting in higher fruit set and ultimately increased the number of fruits per tree. These results are in agreement with the findings of Sarkar *et al*. (2012) [12] in mango and Barne *et al.* (2013) [4] in guava who reported that combined application of organic and inorganic was responsible for better vegetative growth, production of more number of flowers and higher fruit set. The low fruit set in control treatment (T_0) could be the result of less nutrient availability.

3.2 Fruit weight (g)

It is apparent from the table 2 that significantly maximum fruit weight (212.00 g) was recorded with the treatment of 80% RDF + Cow dung slurry @10 lit/tree (T_2) followed by 100% RDF (T_1) whereas minimum fruit weight (170.82 g) was recorded under control (T_0). The treatment T_3 and T_6, T_4 and T_7, T_5 and T_9 were found statistically at par. The Combined application of inorganic and organic fertilizers in 80% RDF + Cow dung slurry@ 10lit/tree improved soil nutrient availability and triggered various biological processes at soil rhizosphere, which provided better nourishment and better utilization of nutrient within the plant resulting in higher fruit growth. The results are in confirmity with the finding of Gautam *et al*., (2012) [6], Sharma (2004) [13] and Patil *et al*. (2010) [11].

3.3 Fruit yield (kg plant^{-1})

The maximum fruit yield (29.60 kg plant^{-1}) was recorded in treatment 80% RDF+ Cow dung slurry@10lit/tree (T_2) fallowed by 100% RDF (T_1). Significantly the minimum fruit yield (14.83 kg plant^{-1}) was recorded under the treatment control (T_0). The treatment T_6 and T_4, T_5 and T_7 were found statistically at par.

3.4 Fruit yield tones ha^{-1}

The maximum fruit yield (11.84 tones ha^{-1}) was recorded in treatment of 80% RDF + Cow dung slurry @10 lit/tree (T_2) fallowed by 100% RDF (T_1) and minimum fruit yield (5.93 tones ha^{-1}) was recorded under the treatment T_0 (Control). The treatment T_6 and T_4 was found statistically at par. The maximum yield in the combined application of organic and inorganic fertilizers is a result of the interaction between them which helped in increasing the soil nutrient availability and their uptake by the plants that resulted in better vegetative growth in terms of shoot length and number of leaves which have produced the higher quantum of carbohydrates needed for the development of the fruits thereby, increasing the number, size and weight of fruits which ultimately leads towards getting higher yield in these treatments. The lowest yield in control treatment (T_0) could be the result of poor vegetative growth on account of scarce nutrient availability in turn, reducing the number, size and weight of the fruits. The results are in conformity with the finding of Kundu *et al*. (2011) [8], Singh *et al*. (2011) [16], Bashir *et al*. (2009) [5] and Barne *et al*. (2013) [4].

Table 2: Effects of organic, inorganic and biofertilizers on number of fruits plant^{-1}, fruit weight, fruit yield kg tree^{-1} and fruit yield MT ha^{-1} of mango

	Treatments	Number of fruits plant^{-1}	Fruit weight (gm)	Fruit yield Kg tree^{-1}	Fruit yield MT ha^{-1}
T_0	Control (Without nutrient application)	85.66	170.82	14.83	5.93
T_1	100% RDF (500:300:500g NPK/tree)	136.33	208.61	28.27	11.30
T_2	80% RDF + Cowdung slurry 10lit/tree	140.33	212.00	29.60	11.84
T_3	80% RDF + Vermiwash 10lit/tree	133.00	204.30	27.00	10.80
T_4	80% RDF + C.G Trychome	128.66	197.97	25.30	10.12
T_5	80% RDF + Azospirillum+PSB	127.66	183.43	23.25	9.30
T_6	60% RDF + Cowdung slurry 10lit/tree	132.00	202.94	25.84	10.33

T7	60% RDF + Vermivash 10lit/tree	126.66	195.90	24.22	9.68
T_8	60% RDF + C.G Trychome	122.33	182.53	20.66	8.26
T_9	60% RDF + Azospirillum + PSB	125.33	183.40	22.45	8.98
	SEm±	0.61	0.82	0.34	0.09
	CD at 5% level	1.84	2.45	1.01	0.28
	CV%	0.85	0.73	2.45	1.74

3.5 Economic studies

In economic studies, the cost of cultivation, gross monetary returns, net monetary returns and benefit: cost ratio of different treatment were calculated and presented in table 3. The highest cost in treatment T_1 and T_5 could be attributed to high cost of biofertilizer and inorganic fertilizer respectively while the lowest cost in control treatment (T_0) could be due to no expenditure was required to words the cost either of application or the input. The highest gross and net monetary returns per hectare (Rs. 236800 and Rs. 167646.86) were obtained in the treatment T_2 (80% RDF + Cowdung slurry @10lit/tree) followed by T_1 (Rs.226000 and Rs 154685.7) and T_3 (Rs. 216000 and Rs. 147087.46) while the lowest gross and net returns per hectare (Rs. 118600 and Rs. 58935.7) were recorded in control (T_0). This could be attributed to production of higher yield of quality fruits in the combined application of organic and inorganic fertilizers while, low yield in control. Treatment leads to poor values of gross and net monetary returns. The results revealed that the highest benefit: cost ratio (1:2.42) was recorded in the treatment of 80% RDF+ Cowdung slurry@ 10lit/tree. The minimum benefit: cost ratio (1:0.98) was recorded in control (T_0). The highest benefit: cost ratio in the treatment of T_2 could be attributed to good gross monetary returns and comparatively moderate cost of cultivation that resulted in high benefit: cost ratio. The lowest benefit: cost ratio in control may be due to lowest gross monetary returns. The results are in good agreement with the finding of Bakhsh *et al*., (2006) [3], Shukla *et al*., (2009) [15], Sharma (2004) [13] and Atom (2013) [2].

Table 3: Effects of organic, inorganic and biofertilizers on economics of mango cultivation

	Treatments	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit: cost ratio
T_0	Control (Without nutrient application)	59664.30	118600	58935.70	1: 0.98
T_1	100% RDF (500:300:500 g NPK/tree)	71314.30	226000	154685.70	1:2.16
T_2	80% RDF + Cowdung slurry 10lit/tree	69153.14	236800	167646.86	1:2.42
T_3	80% RDF + Vermiwash 10lit/tree	68912.54	216000	147087.46	1:2.13
T_4	80% RDF + C.G Trychome	69255.17	202400	133144.83	1:1.92
T_5	80% RDF + Azospirillum + PSB	69653.20	186000	116346.80	1:1.67
T_6	60% RDF + Cowdung slurry 10lit/tree	66908.17	206600	139691.83	1:2.08
T7	60% RDF + Vermivash 10lit/tree	66667.57	193600	126932.43	1:1.90
T_8	60% RDF + C.G Trychome	67010.00	165200	98190.00	1:1.46
T_9	60% RDF + Azospirillum + PSB	67408.23	179600	112191.77	1:1.66

4. Conclusion

Integrated sources of nutrients play important role in improving economical yield of mango. The application of 80% RDF + Cowdung slurry @10lit/tree resulted maximum number of fruits per plant, maximum fruit weight, maximum fruit yield which turn into maximum cost of benefit ratio in mango cv Amrapali.

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