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Short communication

Effect of integrated nutrient management on vegetative growth and yield in mango cv. Himsagar

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ABSTRACT

An experiment was conducted to study the effect of various combinations of integrated nutrient management schedules on vegetative growth and yield in mango cv. Himsagar at Regional Research Station, Gayeshpur, B.C.K.V., Nadia, West Bengal, during the years 2009-2011. Maximum total increment in plant height (108.00 cm), plant spread in E-W direction (123.00 cm) and N-S direction (105.00 cm), and tree volume (85.95 m^3) was recorded in 500:250:250g NPK/tree/year + 50kg FYM + 250g *Azospirillium* (T_6) compared to that in other treatments. This treatment (T_6) also significantly increased total number of fruits (234.12 fruits / tree), average fruit weight (263.10g) and yield (58.56kg /tree).

Key words: Mango, Himsagar, biofertilizer, INM

Mango (*Mangifera indica* L.), the 'King of Fruits,' is an evergreen fruit crop of the tropical and sub-tropical regions with a great economic potential, for, it fulfils the requirement for nutritional, medicinal, commercial, industrial and religious needs (Bihari *et al*, 2012). In India, it is a part and parcel of life, being connected with all phases of life from birth to death (Bose *et al*, 2001). Among fruit crops, it occupies the first place in area in India, occupying 2.29 mha with a production of 151.88 lakh tonnes, constituting 45% of the total world mango production. Production has been increasing since independence, contributing 20.3% of the total fruit produced in India, after banana (39.8%). Uttar Pradesh tops in total production (23.9%), followed by Andhra Pradesh (22.1%). West Bengal, falling also under the major mango-growing belt, contributed about 4.1% of total mango production in India (Indian Horticulture Database, 2011). West Bengal too is a major mango-producing state in India in terms of area and production, and new mango plantations need to be raised every year to supply an increased demand for this fruit. However, indiscriminate application of inorganic fertilizers leads to changes in physical, chemical and biological properties of the soil, besides reducing its fertility and leading to decline in its organic content (Singh *et al*, 2001). Also, use of inorganic carbon fertilizers is detrimental to human health and environment (Arisha and Bardisi, 1999). Estrada (2002) reported that agricultural lands get impoverished with application of high doses of fertilizer which, in turn, pollute the ecosystem significantly. Besides, information on effects of integrated nutrient management on vegetative growth and yield in mango cv. Himsagar in the alluvial tract of West Bengal is lacking. Therefore, the present experiment purported to develop an integrated nutrient management package for mango consisting of organic manure (FYM), inorganic fertilizers and biofertilizers for improving growth and yield in 'Himsagar'.

The present investigation was carried out at Regional Research Station, Gayeshpur, B.C.K.V., Nadia, West Bengal, during the years 2009-2011. The site of the experiment is situated at 22p 57¹ N latitude and 89p 34¹ E longitude, at an average altitude of 9.75m above mean sea level. The experiment was laid out in Randomised Block Design (RBD) in five replications. Age of the trees was seven years, at a spacing of 10m x 10m. The experiment consisted of 10 treatments, viz., T_1: 1000:500:500g NPK/tree (Control), T_2: T_1 + Zn (0.5%) + B (0.2%) + Mn (1%) + Ca (0.6%) as foliar application, twice (Aug & Oct); T_3: T_1 + Organic mulching (10cm thick layer of dry leaves); T_4: T_2 + Organic mulching (10cm thick layer of dry leaves); T_5: ½ T_1 + 50kg FYM + 250g *Azospirillium*; T_6: ½ T_1 + 50kg FYM + 250g *Azospirillium*; T_7: ½ T_1 + 250g *Azotobacter* + 250g

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Azospirillium; T_8: ½ T_1 + 50kg FYM + 250g *Azotobacter*; T_9: ½ T_1 + 50kg FYM + 250g *Pseudomonas florescence*; T_{10}: ½ T_1 + 50kg FYM + 250g *Pseudomonas florescence* + 250g *Trichoderma*. Every plant treated was supplemented with the dose set for each treatment from the month of March after flowering. Treatments, along with mulches (dry wheat-straw leaves), were applied at a thickness of 8-10cm and retained in the field for three years for soil moisture conservation and increased organic matter in soil. Nutrient fertilizers (N, P and K) were provided in the form of urea (46% N), single super phosphate (16% P_2O_5) and potassium sulphate (50% K_2O), respectively, and applied in two split doses in March (at the marble stage of fruit development) and July (after harvest). Vegetative growth parameters were recorded after harvest (in June) and, again, before initiation of the next flowering (December). Yield parameters were also recorded. Irrigation was applied after the fertilizer and, subsequently, as and when required (depending upon the rainfall). Irrigation was stopped 7-10 days before harvest.

Plant growth parameters showed significant variation under different treatments (Table 1, 2, 3 & 4). Plants grown under 500:250:250g NPK/tree + 50kg FYM + 250g *Azospirillium* (T_6), showed improved vegetative growth parameters compared to other treatments. However, T_2 + Organic mulching (10cm thick layer of dry leaves) (T_4) caused the maximum total increment in canopy height, closely followed by 500:250:250g NPK/tree + 50kg FYM + 250g *Azospirillium* (T_6). These findings are similar to those of Sivakumar (2001) and Shulka *et al* (2009). Further, Gautam *et al* (2012) found in mango cv. Sunderja, that application of 500:250:250g N:P:K/tree + 50kg FYM + 10kg Vermicompost registered maximum plant height, canopy height, plant spread (N-S and E-W) and tree volume compared to the Control 500:250:250g N:P:K/tree. Vegetative parameters were superior in the treatment with nitrogen fixing bacteria, viz., *Azotobacter* and *Azopirillium.* This could be due to the higher nitrogen content in soil, essential for growth of the plant system. Subba Rao *et al* (1980) also reported inoculation of *Azotobacter* and *Azospirillium* in several non-legumes crops as contributing

Table 1. Effect of integrated nutrient management (INM) on plant height in mango cv. Himsagar

Treatment	Dec 2008 (m)	June 2009 (m)	Increase (cm)	Dec 2009 (m)	Increase (cm)	June 2010 (m)	Increase (cm)	Dec 2010 (m)	Increase (cm)	June 2011 (m)	Increase (cm)	Total increase (cm)
T_1	5.02	5.16	14.00	5.31	15.00	5.44	13.00	5.57	13.00	5.73	16.00	71.00
T_2	4.86	5.03	17.00	5.19	16.00	5.36	17.00	5.52	16.00	5.71	19.00	85.00
T_3	4.65	4.83	18.00	4.99	16.00	5.16	17.00	5.31	15.00	5.50	19.00	85.00
T_4	4.95	5.13	18.00	5.30	17.00	5.48	18.00	5.64	16.00	5.82	18.00	87.00
T_5	4.76	4.99	23.00	5.16	17.00	5.34	18.00	5.48	14.00	5.67	19.00	91.00
T_6	5.30	5.52	22.00	5.72	20.00	5.91	19.00	6.08	17.00	6.38	30.00	108.00
T_7	4.78	4.96	18.00	5.13	17.00	5.30	17.00	5.46	16.00	5.65	19.00	87.00
T_8	4.46	4.65	19.00	4.84	19.00	5.02	18.00	5.21	19.00	5.39	18.00	93.00
T_9	5.05	5.23	18.00	5.42	19.00	5.59	17.00	5.76	17.00	5.93	17.00	88.00
T_{10}	4.83	5.02	19.00	5.19	17.00	5.36	17.00	5.52	16.00	5.73	21.00	90.00
SE±m	0.15	0.15	-	0.12	-	0.15	-	0.13	-	0.12	-	-
CD *(P=0.05)*	0.43	0.34	-	0.34	-	0.44	-	0.39	-	0.35	-	-

Table 2. Effect of integrated nutrient management (INM) on tree volume of mango cv. Himsagar

Treatment	Dec 2008 (m^3)	June 2009 (m^3)	Increase (m^3)	Dec 2009 (m^3)	Increase (m^3)	June 2010 (m^3)	Increase (m^3)	Dec 2010 (m^3)	Increase (m^3)	June 2011 (m^3)	Increase (m^3)	Total increase (m^3)
T_1	67.30	74.38	7.08	82.98	8.60	92.41	9.43	101.91	9.50	112.88	10.97	45.58
T_2	75.02	85.61	10.59	96.54	10.93	108.60	12.06	121.31	12.71	136.72	15.41	61.70
T_3	57.88	67.26	9.38	77.16	9.90	87.09	9.93	99.98	12.89	113.80	13.82	55.92
T_4	76.07	87.29	11.22	99.46	12.17	117.50	18.04	127.45	9.95	147.36	19.91	71.29
T_5	76.07	92.24	16.17	106.93	14.69	118.20	20.75	135.53	17.33	151.90	16.37	75.83
T_6	99.53	116.09	16.56	132.58	16.49	150.81	15.23	166.68	15.87	185.48	18.80	85.95
T_7	56.02	64.36	8.34	73.46	9.10	83.35	9.89	94.73	11.38	107.63	12.90	51.61
T_8	67.71	78.84	11.13	90.92	12.08	105.29	14.37	118.69	13.40	134.84	16.15	67.13
T_9	81.90	92.93	11.03	105.11	12.18	117.75	12.46	131.93	14.18	146.83	14.90	64.93
T_{10}	70.99	80.92	9.99	91.33	10.41	107.20	15.87	117.50	10.30	131.45	13.95	60.46
SE±m	5.72	7.21	—	6.55	—	7.44	—	11.35	—	8.70	—	—
CD *(P=0.05)*	16.27	20.5	—	18.61	—	21.14	—	32.24	—	24.73	—	—

Table 3. Effect of integrated nutrient management (INM) on plant-spread (North – South) in mango cv. Himsagar

Treatment	Dec 2008 (m)	June 2009 (m)	Increase (cm)	Dec 2009 (m)	Increase (cm)	June 2010 (m)	Increase (cm)	Dec 2010 (m)	Increase (cm)	June 2011 (m)	Increase (cm)	Total increase (cm)
T_1	5.09	5.24	15.00	5.39	15.00	5.55	16.00	5.75	20.00	5.91	16.00	82.00
T_2	5.29	5.47	18.00	5.66	19.00	5.82	16.00	6.01	19.00	6.21	20.00	0.92
T_3	4.73	4.92	19.00	5.11	19.00	5.26	15.00	5.55	29.00	5.69	14.00	0.96
T_4	4.99	5.17	18.00	5.36	19.00	5.56	20.00	5.75	19.00	5.93	18.00	0.94
T_5	5.5	5.69	19.00	5.87	18.00	6.07	20.00	6.29	22.00	6.49	20.00	0.99
T_6	5.68	5.89	16.00	6.10	19.00	6.29	17.00	6.54	25.00	6.73	19.00	1.05
T_7	5.41	5.57	16.00	5.76	19.00	5.93	17.00	6.14	21.00	6.30	16.00	0.89
T_8	5.30	5.50	20.00	5.70	20.00	5.88	18.00	6.08	20.00	6.29	21.00	0.99
T_9	5.50	5.68	18.00	5.85	17.00	6.02	17.00	6.22	20.00	6.39	17.00	0.89
T_{10}	5.35	5.55	20.00	5.72	17.00	5.90	18.00	6.09	19.00	6.26	17.00	0.91
SE±m	0.25	0.26	—	0.25	—	0.25	—	0.27	—	0.26	—	—
CD *(P=0.05)*	NS	NS	—	NS	—	NS	—	0.78	—	0.76	—	—

Table 4. Effect of integrated nutrient management (INM) on plant-spread (East – West) in mango cv. Himsagar

reatment	Dec 2008 (m)	June 2009 (m)	Increase (cm)	Dec 2009 (m)	Increase (cm)	June 2010 (m)	Increase (cm)	Dec 2010 (m)	Increase (cm)	June 2011 (m)	Increase (cm)	Total increase (cm)
T_1	4.64	4.82	18.00	4.988	16.00	5.17	19.00	5.34	17.00	5.49	15.00	85.00
T_2	5.15	5.34	19.00	5.524	18.00	5.71	19.00	5.89	18.00	6.10	21.00	95.00
T_3	4.74	4.94	20.00	5.138	19.00	5.39	26.00	5.56	17.00	5.75	19.00	101.00
T_4	5.61	5.84	23.00	6.042	20.00	6.24	20.00	6.43	19.00	6.64	21.00	103.00
T_5	5.52	5.74	22.00	5.892	15.00	6.13	24.00	6.32	19.00	6.54	22.00	102.00
T_6	5.67	5.96	29.00	6.204	24.00	6.48	28.00	6.68	20.00	6.90	22.00	123.00
T_7	4.11	4.31	20.00	4.482	17.00	4.69	21.00	4.86	17.00	5.06	20.00	95.00
T_8	5.02	5.27	25.00	5.488	21.00	5.76	28.00	5.95	19.00	6.16	21.00	114.00
T_9	5.00	5.18	18.00	5.364	18.00	5.57	21.00	5.75	18.00	5.93	18.00	93.00
T_{10}	4.89	5.07	18.00	5.252	18.00	5.51	26.00	5.69	18.00	5.85	16.00	96.00
SE±m	0.26	0.24	—	0.26	—	0.26	—	0.27	—	0.27	—	—
CD *(P=0.05)*	0.74	0.70	—	0.75	—	0.76	—	0.76	—	0.76	—	—

Table 5. Effect of integrated nutrient management (INM) on yield in mango cv. Himsagar

Treatment	No. of fruits / tree				Average fruit weight (g)				Fruit yield (kgme)			
	2009	2010	2011	Pooled	2009	2010	2011	Pooled	2009	2010	2011	Pooled
T_1	21.00	178.00	158.00	119.00	224.506	231.28	232.38	229.38	5.05	38.58	40.41	28.02
T_2	32.25	267.00	240.00	175.43	233.8	239.30	234.20	235.76	7.51	61.77	53.15	40.81
T_3	80.25	245.20	246.00	180.05	226.35	246.76	248.06	232.57	21.29	63.71	55.29	46.76
T_4	50.00	271.40	246.00	189.13	239.45	245.98	246.94	244.12	10.01	65.97	58.82	44.93
T_5	60.60	262.20	275.00	199.26	222.50	244.08	240.02	235.77	17.74	65.48	62.78	48.66
T_6	74.66	294.00	333.70	234.12	243.00	255.58	290.74	263.10	21.90	71.95	81.85	58.56
T_7	55.00	196.75	216.00	153.91	222.6	239.332	255.98	239.30	13.72	47.57	44.65	35.31
T_8	78.00	280.75	261.75	206.83	244.22	250.62	265.82	253.55	20.81	65.91	63.18	49.97
T_9	25.00	278.00	245.80	177.60	235.15	239.40	255.70	243.41	9.04	62.95	61.77	44.59
T_{10}	51.00	259.00	254.00	194.33	237.00	247.02	260.62	248.27	13.78	68.10	61.38	47.75
SE±m	8.40	8.32	10.16	6.49	4.02	5.63	10.25	3.90	2.76	3.60	7.65	1.37
CD *(P=0.05)*	23.88	23.63	28.87	18.45	11.42	NS	29.11	11.09	7.76	8.70	2.69	3.91

about 25kgN / ha through fixation in soil, leading to better plant growth and 5-15% higher yield.

Results also revealed that yield parameters (Table 5) such as number of fruits/tree, average fruit weight and yield (kg/tree) increased under different combinations of integrated nutrient management compared to that in Control (T_1) (1000:500:500g N:P:K/tree). Significantly high cumulative yield was obtained in ½ T_1+ 50kg FYM + 250g *Azospirillium* (T_6) followed by ½ T_1 + 50kg FYM + 250g *Azotobacter* (T_8), while significantly lower value was seen in Control. These finding are in line with those of Patel *et al* (2005). Hasan *et al* (2009) too observed maximum flowering and fruiting in trees supplied with 50% recommended dose

Fig. 1. Observations on girth and plant-spread

Fig. 2. Observations on plant height

Fig. 3. Harvested fruit of mango cv. Himsagar under treatment T_6

Fig. 4. Heavy bearing under treatment T_6

of nutrients along *Azospirillium* and VAM inoculation. Further, Yadav *et al* (2011) reported in mango cv. Amrapali that the recommended NPK + Vermicompost + *Azotobacter* + PSB + Zn + Fe + Paclobutrazol application recorded optimum yield compared to that in Control (recommended NPK/tree). Similarly, Gautam *et al* (2012) found that application of 500:250:250g N:P:K/tree + 50kg FYM + 10kg Vermicompost registered maximum number of fruits/tree compared to Control (500:250:250g N:P:K/tree). Therefore, it can be concluded that integration of inorganic fertilizer with biofertilizers improves vegetative growth and yield in mango, without affecting fruit quality. This can be recommended for sustainable mango production with minimal use of fertilizer under the alluvial zone of West Bengal.

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REFERENCES

Arisha, H.M. and Bradisi, H. 1999. Effect of mineral fertilizers and organic fertilizers on growth, yield and quality of potato under sandy soil condition. *Zagazig.*

J. Agril. Res., **26**:391-405

Indian Horticulture Database. 2011. All India area and production of fruits and vegetables. National Horticultural Board, Ministry of Agriculture, Govt. of India. pp. 3-4. (http.//www.nhb.gov.in)

Bihari, M., Singh, R.K., Kumar, A., Prasad, A., Narayan, S. and Pandey, S.K.N. 2012. Quality parameters studies on *Mangifera* genus and varieties. *Indian J. Hort*., **69**:272-276

Bose, T.K., Mitra, S.K. and Sanyal, D. 2001. Mango. In: *Fruits: Tropical and Subtropical* Volume 1, 3rd edition. Naya Udyog, Kolkota, West Bengal, pp 1-108

Estrada, C.G. 2004. Evaluation of a biofertilizer, clearing and fruit bagging in mango 'Kent'. *Acta Hort*., **645:**217-221

Gautam, U.S., Singh, R., Tiwari, N., Gurjar, P.S. and Kumar, A. 2012. Effect of Integrated Nutrient Management in mango cv. Sunderja. *Indian J. Hort*., **69**:151-155

Hasan, M.A., Chowdhury, R.R., Mandal, K.K., Majumdar, D. and Das, A. 2009. Effect of organic and inorganic nutrients in improving flowering of mango. *Crop Res*., **37**:95-100

Patel, V.B., Singh, S.K., Ram, A. and Sharma, Y.K. 2005. Response of organic manures and bio-fertilizer on growth, fruit yield and quality of mango cv. Amrapali under high density orcharding. *Karnataka J. Hort*., **1**:51-56

Singh, M., Singh, V.P. and Reddy, K.S. 2001. Effect of integrated use of fertilizer nitrogen and farm-yard manure or green manure on transformation of N, P and S and productivity of rice-wheat system on vertisols. *J. Indian Soc. Soil Sci.,* **49**:430-435

Sivakumar, U. 2001. Effect of bacterial inoculation on mango (*Mangifera indica* L.) rootstock. *Madras Agril. J.* **88**:486-487

Shukla, A.C., Saralia, D.K., Bhavna, K., Kaushik, R.A., Mahawar, L.N. and Bairwa, H.L. 2009. Evaluation of substrate dynamics for INM under high density planting of guava cv. Sardar. *Indian J. Hort*., **66**:461-464

Subba Rao, N.S., Tilak, K.V. and Singh, C.S. 1980. Yield response of rice to root inoculation with *Azospirillium. J. Genet. Appl. Microbiol*., **44**:365-70

Yadav, A.K., Singh, J.K. and Singh, H.K. 2011. Studies on integrated nutrient management in flowering, fruiting, yield and quality of mango cv. Amrapali under high density orcharding. *Indian J. Hort*., **68**:453-460

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