International Journal of Farm Sciences **2(1)** : 17-28, 2012

Apple productivity and soil properties under organic farming in temperate zone of Himachal Pradesh

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ABSTRACT

Results of investigations conducted during 2004 and 2005 at the experimental farm of Regional Horticultural Research Station, Mashobra, Shimla, Himachal Pradesh to study the soil moisture distribution, nutrient content and apple productivity of cv Red Delicious under organic farming technology using commercial organic manure and farm yard manure (FYM) revealed improvement in soil moisture availability, pH, organic carbon and nutrient status. Growth parameters, fruit characteristics and yield were recorded maximum under T_3 (commercial organic manure @ 5 kg/tree) during 2004, T_4 (commercial organic manure @ 10 kg/tree) during 2005 and T_2 (Farm Yard Manure @ 100 kg/tree) during both of years of experimentation and minimum under T_1 (without manure-control) during 2004 and 2005. Soil moisture, pH, organic carbon and available N, P and K were recorded maximum under T_2 (Farm Yard Manure @ 100 kg/tree) and T_6 (commercial organic Manure @20 kg/tree) during 2004 and 2005 respectively. Better quality apple fruits were also recorded under T_3 during 2004, T_4 during 2005 and T_2 during both the years of experimentation.

Keywords: Apple yield, quality, organic manures, soil moisture, nutrient content

INTRODUCTION

The increasing cost of fertilizers, growing ecological concern and conservation of energy have created considerable interest in the use of organics as source of plant nutrients as well as to accelerate the activity of microbes in building up soil fertility. Organic farming technology solely depends on the use of crop residues, animal manures, green manures, off-farm organic wastes, crop rotation incorporating legumes and biological pest control to maintain soil productivity (Palaniappan and Annadurai 1999). Thus the concept of organic farming has created a renewed interest in the use of organic manures. Hence there is urgent need to explore the new sources of suitable organic manures.

Commercial organic manure is made from plant waste substances like neem and caster cakes and animal waste material like fishmeal etc. Presently many brands of commercial organic manures are available in the market. Suitability of these manures in apple production is less known. Thus the present investigations were undertaken to study the effect of commercial organic manures and farm yard manure (FYM) on apple productivity and soil fertility.

MATERIAL AND METHODS

The studies were conducted during 2004 and 2005 at the research farm of Regional Horticultural Research Station, Mashobra, Shimla, Himachal Pradesh on a silty clay loam soil in a 25 years old apple orchard of cv Red Delicious. The treatments tried in randomized block design with five replications were T_1- control, without manure, T_2- farm yard manure (FYM) @ 100 kg/tree-recommended dose, T_3- commercial organic manure @ 5 kg/tree, T_4- commercial organic manure @ 10 kg/ tree, T_5- commercial organic manure @ 15 kg/tree and T_6- commercial organic manure @ 20 kg/tree. Initial soil chemical properties were determined using standard procedures.

The experimental soil was near neutral in soil reaction (6.21), high in organic carbon (1.08%), medium in soil available nitrogen (473.50 kg ha^{-1}), phosphorus (15.20 kg ha^{-1}) and potassium (267.30 kg ha^{-1}). During crop growth period changes in soil moisture content (w/w basis) was recorded gravimetrically up to 30 cm soil depth. Post harvest soil samples were drawn to study the changes in soil chemical properties with the application of organic manures. Data on growth parameters like terminal shoot growth, plant girth, height, spread, fruit characteristics like fruit weight, length, breadth and finally the yield were recorded at the harvesting stage of the apple crop. Plant spread was estimated with the help of measuring wooden rod by recording the maximum canopy spread in north–south and east–west directions. Total soluble solids (TSS) and fruit pressure were determined by Hand Refractometer and Fruit Pressure Tester respectively. Titratable acidity and total sugar content of fruits were estimated as per standard AOAC procedure (Anon 1980). No fertilizer, pesticide or herbicide was applied. Weeding was carried manually. The bulk density of soil recorded before experimentation was 1.15 gm cm^{-3} and 1.13 gm cm^{-3} after application of organic manure and farm yard manure in the soil. The rainfall data for 2004 and 2005 for entire experimentation period are presented in Table 1. Nitrogen, phosphorus, potassium and moisture contents of commercial organic manure and farm yard manure (FYM) used in experimentation are depicted in Table 2.

Table 1. Rainfall data for 2004 and 2005 for entire experimentation period

Months	Rainfall (mm)	
	Year	
	2004	2005
January	27.3	7.3
February	11.2	98.9
March	—	162.2
April	58.6	33.2
May	135.4	21.4
June	146.0	142.1
July	285.7	594.0
August	198.5	132.2
September	70.8	104.6
October	127.0	1.6
November	5.4	—
December	—	69.8

Table 2. Nitrogen, phosphorus, potassium and moisture contents of commercial organic manure and farm yard manure used in experimentation

S. No.	Particular	Commercial Organic manure	Farm yard manure
1.	Total N (%)	1.04	0.82
2.	P (%)	0.57	0.40
3.	K (%)	0.71	0.47
4.	Moisture content (% on oven dry weight basis)	72	60

Table 3. Impact of commercial organic manure and FYM application on soil moisture content (%) in apple orchard during 2004 and 2005

	2004						2005						
Treatment	16.4.04	7.5.04	25.5.04	15.06.04	5.7.04	26.7.04	12.4.05	28.4.05	16.5.0 5	31.5.05	17.6.05	4.7.05	1.8.05
T_1	32.30	28.70	29.30	28.80	31.10	29.40	32.10	34.10	29.20	28.80	26.60	27.90	32.25
T_2	36.90	36.00	37.20	35.80	38.70	37.20	38.40	41.25	33.20	35.40	33.00	33.00	39.00
T_3	35.10	35.10	36.00	34.00	37.10	36.00	36.50	38.30	31.25	31.45	30.20	30.00	33.20
T_4	35.70	35.30	36.40	34.20	37.40	36.20	36.60	38.50	31.50	31.55	30.40	30.10	33.45
T_5	36.00	36.00	36.60	34.50	37.60	36.30	36.80	38.75	31.65	31.60	30.60	30.45	33.60
T_6	36.60	36.50	37.00	35.20	37.90	36.90	36.95	38.90	31.70	31.75	30.85	30.60	33.80

RESULTS AND DISCUSSION

Soil moisture distribution

There was improvement in soil moisture availability due to incorporation of organic manure and FYM (Table 3) during the years 2004 and 2005. Maximum moisture content was recorded under T_6 (commercial organic manure @ 20 kg/tree) and T_2 (Farm Yard Manure @ 100 kg / tree) treatments and minimum under treatment T_1 (control-without manure) during all the moisture recording dates under the years 2004 and 2005. This increase in soil moisture content was probably caused by improvement in organic carbon content of the soil (Table 4).

Soil nutrient content

Soil nutrient content was improved due to the application of commercial organic manure and FYM (Table 4) during the years 2004 and 2005. Increase in quantities of organic manure resulted increase in organic carbon contents in both the years of study. Treatment T_6 (commercial organic manure @ 20 kg/tree) recorded highest organic carbon contents (1.22 and 1.25%) which was significantly higher as compared to T_1 (control-without manure) treatment during both the years of experimentation. Improvement in organically treated plots might be due to the direct addition of organic matter through FYM and commercial organic manure and recycling of organic materials in the form of crop residues like roots and leaf fall. Higher organic carbon content with incorporation of organic manures, FYM and crop residues etc has also been reported by Gupta et al (2000) in rice-wheat sequence, Tiwari et al (2000) in wheat, Chaudhary et al (2003) in vegetables, Verma and Bhardwaj (2005) in apple and Kumar et al (2008) in rice-wheat system. However in control plot a decreasing trend in organic carbon status was observed. There was also increase in the available N, P and K contents of soil and its pH after the harvest of apple fruits due to the application of commercial organic manure and farm yard manure (FYM). Maximum contents of N (479.20 and 475.60 kg ha^{-1}), P (18.60 and 16.95 kg ha^{-1}) and K (264.70 and 258.55 kg ha^{-1}) were recorded in T_6 (commercial organic manure @ 20 kg/tree) during 2004 and 2005 and also in FYM @ 100 kg/tree with N content of 480.00 and 483.80 kg ha^{-1} , P content of 19.00 and 19.50 kg ha^{-1} and K content of 269.80 and 277.80 kg ha^{-1} during first and second year of experimentation. These findings were similar to the observations of Kumar and Mishra (1991) in rice and maize crops, Chaudhary et al (2003) in vegetables and Verma and Bhardwaj (2005) in apple.

Plant growth

Plant growth parameters viz terminal shoot growth, plant girth, height and spread were significantly affected by organic manures treatments (Table 5) during 2004 and 2005. Maximum terminal shoot growth (45.00 and 41.70 cm), plant girth

Table 4. Soil pH, organic carbon, available nitrogen, phosphorus and potassium contents as influenced by commercial organic manure and FYM application in apple orchard during 2004 and 2005

Treatment	pH		Organic carbon content (%)		Nitrogen (kgha^{-1})		Phosphorus (kgha^{-1})		Potassium (kgha^{-1})	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
T_1	6.00	6.40	1.02	1.12	467.40	471.75	16.10	16.60	254.00	255.00
T_2	6.25	6.70	1.14	1.23	480.00	483.80	19.00	19.50	269.80	277.80
T_3	6.00	6.55	1.00	1.18	470.80	474.95	16.60	16.60	255.10	257.80
T_4	6.10	6.60	1.16	1.22	472.70	475.00	17.15	16.75	259.00	257.90
T_5	6.20	6.65	1.17	1.24	475.80	475.20	18.00	16.80	262.20	258.30
T_6	6.40	6.75	1.22	1.25	479.20	475.60	18.60	16.95	264.70	258.55
$CD_{0.05}$	0.27	N.S.	0.13	0.06	1.92	0.87	0.65	0.32	2.07	0.89

Table 5. Effect of commercial organic manure and FYM incorporation on terminal shoot growth, plant girth, height and spread of apple trees during 2004 and 2005

Treatment	Terminal shoot growth (cm)		Plant girth (cm)		Plant height (m)		Plant spread (m) North- South Direction		Plant spread (m) East-West Direction	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
T_1	38.70	39.90	79.00	79.40	4.00	4.90	3.25	4.05	3.40	4.30
T_2	42.00	43.05	81.00	82.20	5.40	5.90	4.80	5.60	5.00	5.85
T_3	45.00	41.65	82.60	81.60	5.80	5.65	5.20	4.70	5.40	5.25
T_4	42.90	41.70	80.10	82.00	5.20	5.70	5.00	4.80	5.10	5.30
T_5	41.20	41.40	78.80	81.35	5.00	5.50	4.60	4.40	4.80	5.00
T_6	39.00	41.30	78.00	81.20	4.75	5.30	4.40	4.20	4.60	4.85
$CD_{0.05}$	1.27	0.44	1.48	0.80	0.19	0.29	0.53	0.26	0.32	0.23

(82.60 and 82.00 cm), height (5.80 and 5.70 m) and spread (5.20 and 4.80 m N-S and 5.40 and 5.30 m E-W) in apple were recorded under T_3 (commercial organic manure @ 5 kg/tree) and T_4 (commercial organic manure @ 10 kg/tree) respectively during 2004 and 2005 and under T_2 (farm yard manure @ 100 kg/tree) during 2004 and 2005, the values of terminal shoot growth (42.00 and 43.05 cm), plant girth (81.00 and 82.20 cm), height (5.40 and 5.90 m), spread (4.80 and 5.60 m N-S and 5.00 and 5.85 m E-W) were also recorded maximum. Chaudhary et al (2003) in tomato and Verma and Bhardwaj (2005) in apple reported similar responses with the application of organic materials. However in control-without manure (T_1) plot the lowest terminal shoot growth, plant girth, height and spread in apple, were recorded during the years 2004 and 2005.

Fruit characteristics and yield

Fruit characteristics like fruit weight (220.70 and 219.10 g), length (8.90 and 7.50 cm), breadth (8.00 and 7.65 cm) and yield (64.80 and 65.90 kg/tree) in apple were recorded maximum under T_3 (commercial organic manure @ 5 kg/tree and T_4 (commercial organic manure @ 10 kg/tree) during 2004 and 2005 respectively and under T_2 (farm yard manure @ 100 kg/tree) during 2004 and 2005, the values of fruit weight (218.10 and 221.65 g), length (7.10 and 8.65 cm), breadth (7.80 and 8.80 cm) and yield (64.20 and 67.80 kg/tree) were also recorded maximum (Table 6). Similar results were also reported by Thanuanathan et al (1997) in onion, Gupta et al (2000) in rice and wheat, Chaudhary et al (2003) in tomato and Verma and Bhardwaj (2005) in apple with the application of organic materials.

Higher tomato yield and fruit weight obtained with the combined use of vermicompost and FYM were possibly due to supply of balanced nutrition (Tiwari et al 2000 and Chaudhary et al 2003), provision of congenial physical and biological environment of soil and stimulation on N fixation, P solublisation and the thiosulphate oxidizing power (Mukherjee et al 2000).

Fruit quality

Fruit quality parameters like fruit pressure, total soluble solids (TSS), titratable acidity and total sugar contents were significantly affected by different organic manure treatments during 2004 and 2005 except fruit pressure during 2004 (Table 7). Fruit pressure (19.30 and 18.95 Ib/inch^2) and titratable acidity (0.21 and 0.16 %) were recorded the highest under T_3 (commercial organic manure @ 5 kg/tree) during 2004 and under T_4 (commercial organic manure @ 10 kg/tree) during 2005, respectively and under T_2 (farm yard manure @ 100 kg/tree) during 2004 and 2005 the values of fruit pressure (18.80 and 19.00 Ib/inch^2) and titratable acidity (0.20 and 0.21 %) were also recorded maximum. Total soluble

Table 6. Impact of commercial organic manure and FYM application on fruit weight, length, breadth and yield of apple during 2004 and 2005

Treatment	Fruit weight (g)		Fruit length (cm)		Fruit breadth (cm)		Fruit yield (kg/tree)	
	2004	2005	2004	2005	2004	2005	2004	2005
T_1	210.20	213.50	6.00	6.09	5.85	6.50	60.00	61.55
T_2	218.10	221.65	7.10	8.65	7.80	8.80	64.20	67.80
T_3	220.70	218.65	8.90	7.45	8.00	7.45	64.80	65.70
T_4	220.00	219.10	8.10	7.50	7.90	7.65	64.10	65.90
T_5	219.80	218.25	7.70	7.35	7.70	7.20	63.80	65.00
T_6	218.70	216.70	6.30	7.25	7.20	6.95	64.50	64.50
$CD_{0.05}$	5.20	1.17	0.88	0.40	0.87	0.26	1.92	0.53

Table 7. Influence of commercial organic manure and FYM incorporation on fruit pressure, total soluble solids (TSS), titratable acidity and total sugar in apple during 2004 and 2005

Treatment	Fruit pressure (lb/inch^2)		Total soluble solids (^{0}Brix)		Acidity (%)		Total sugar (%)	
	2004	2005	2004	2005	2004	2005	2004	2005
T_1	17.50	17.90	14.8	14.7	0.07	0.07	10.50	12.10
T_2	18.80	19.00	13.0	12.8	0.20	0.21	8.50	10.00
T_3	19.30	18.80	13.8	13.8	0.21	0.15	9.50	10.50
T_4	19.00	18.95	14.2	13.6	0.20	0.16	9.90	10.30
T_5	18.70	18.75	14.4	14.2	0.18	0.14	10.20	10.80
T_6	19.00	18.60	14.6	14.4	0.17	0.12	10.00	11.20
$CD_{0.05}$	N.S.	0.40	1.10	1.19	0.08	0.03	0.97	0.35

solids (13.8 and 13.6 ^{0}Brix) and total sugar (9.50 and 10.30%) were recorded lowest under T_3 during 2004 and T_4 during 2005 respectively and under T_2 (FYM @ 100 kg/tree); the values of TSS (13.0 and 12.8 ^{0}Brix) and total sugar (8.50 and 10.00 %) during 2004 and 2005 respectively were also recorded minimum. However in control-without manure plot (T_1) fruit pressure and titratable acidity were recorded lowest whereas total soluble solids (TSS) and total sugar were recorded the highest during the years 2004 and 2005. The reason for the higher TSS and total sugar under low moisture regime in control-without manure treatment may be that under moisture stress conditions the ripening is hastened thus increasing the total soluble solids (TSS) and total sugar. The reason for lower acidity and fruit pressure under drier condition in control treatment may be due to over-ripening of fruits.

CONCLUSIONS

Investigations clearly indicated that there was improvement in soil moisture availability, soil pH, organic carbon and nutrient status of the soil due to the incorporation of commercial organic manure and FYM in apple orchard. The results further suggested that either application of FYM @ 100 kg/tree or commercial organic manure @ 5-10 kg/tree could be the best option for getting good yield of quality apple fruits in Himachal Pradesh.

REFERENCES

Anonymous 1980. Official methods of analysis of analytical chemists. 13th Edn, Association of Official Analytical Chemists, AOAC, Washington DC, pp 617-623.

Chaudhary RS, Anchal Das and Patnaik US 2003. Organic farming for vegetable production using vermicompost and FYM in Kokriguda Watershed of Orissa. Indian Journal of Soil Conservation **31**: 203-206.

Gupta RK, Arora BR, Sharma KN and Ahluwalia SC 2000. Influence of biogas slurry and FYM application on the changes in soil fertility under rice-wheat sequence. Journal of Indian Society of Soil Science **48**: 500-505.

Kumar B, Gupta RK and Bhandari AL 2008. Soil fertility changes after long term application of organic manures and crop residues under rice-wheat system. Journal of Indian Society of Soil Science **56 (1)**: 80-85.

Kumar V and Mishra B 1991. Effect of two types of press mud cake on growth of Rice-Maize and soil properties. Journal of Indian Society of Soil Science **39**: 109-113.

Mukherjee D, Das S, Saha N, Sahu SS, Chakravarty A, Halder M, Bhattacharya K and Mukhopadhyay N 2000. Microbiological changes during the process of composting. Extended Summaries: International Conference on Managing Natural Resources, New Delhi, 14-18 Feb 2002, pp 712-714.

Palaniappan SP and Annadurai K 1999. Organic farming: theory and practice. Scientific Publishers (India), Jodhpur.

Thanuanathan K, Natarajan S, Senthil Kumar P and Arulmurugan K 1997. Effect of different sources of organic amendments on growth and yield of onion. Madras Agricultural Journal **84**: 382-384.

Tiwari VN, Tiwari KN and Upadhyay RM 2000. Effect of crop residues and biogas slurry incorporation in wheat on yield and soil fertility. Journal of Indian Society of Soil Science **48**:515-520.

Verma ML and Bhardwaj SP 2005. Organic farming for apple production using ramban organic manure in temperate zone of Himachal Pradesh. The Horticultural Journal **18**: 94-97.

Received :2.7.2011 *Accepted: 9.9.2011*