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Effect of integrated nutrient management on yield of chilli (*Capsicum annum* L.) and physicochemical properties of soil in Kashmir region

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Abstract
Present investigation was carried out at Vegetable Experimental Field, Division of Vegetable Science, SKUAST-Kashmir during Kharif 2013 and Kharif 2014. The experiment was laid out in randomized block design with three replications and comprised of 18 treatments. Observations were recorded on plant yield, soil physical and chemical characteristics. Treatment T17 (RFD 75% + Farmyard manure + Sheep manure + Poultrymanure + Vermicompost + Biofertilizers) recorded significantly higher values for fruit yield per plant (512.28 g), red ripe fruit yield per hectare (173.42 q), dry fruit yield per hectare (55.65 q), pH (6.782), Electrical conductivity (0.124dsm^{-1}) and Organic carbon(1.504%).

Keywords: chilli, yield, electrical conductivity and organic carbon

Introduction
Chilli is one of the commercial high value crops in our country. It is a crop of tropical and sub-tropical regions and requires a warm humid climate. It can be grown in well-drained, loamy soils rich in organic matter. It has been originated in South America and was introduced to India by Portuguese in the seventeenth century. It belongs to family Solanaceae, genus Capsicum. It is cultivated in almost all Indian states, although its cultivation is mainly concentrated in southern states viz., Andhra Pradesh, Karnataka, Tamil Nadu and Orissa. India contributes one fourth of world's production of chilli. Adequate and balanced fertilizer management in association with manures is very much essential to exploit the full yield potential of Chilli. After the green revolution, increase in production was achieved at the cost of soil health. Use of organic manures to meet the nutrient requirements of crop would be an inevitable practice in the years to come for sustainable agriculture since organic manures not only improve the physical, chemical and biological properties of soil (Heitkamp *et al*., 2011) [3] but also improves the moisture holding capacity of soil. Also use of organic manures alone cannot fulfil the crop nutrients requirement. Mixture of organic manures and inorganic fertilizers gave better results than organic manure alone. The integrated supply and use of plant nutrients from chemical fertilizers and organic manures has shown to produce higher crop yields than when they are applied alone. Hence, the present investigation was carried out to find out the effect of Integrated Nutrient Management on yield of chilli (*Capsicum annum* L.) and physio-chemical properties of soil.

Materials and Methods
The present investigation pertaining to the effect of Integrated Nutrient Management on yield of chilli (*Capsicum annum* L.) and physico-chemical properties of soil in Kashmir region was conducted during 2013-2014. Chilli (*Capsicum annuum* L.) var. Kashmir long was taken with a spacing of 30 X 45 cm. There were eighteen treatment combinations in three replications and the details are as follows: Treatments comprised of T1 Control No Organic/Chemical fertilizers, T2 Farmyard manure, T3 Sheep manure, T4 Poultry manure, T5 Vermicompost, T6 Recommended fertilizer dose 50% + Farmyard manure, T7 Recommended fertilizer dose 50% + Sheep manure, T8 Recommended fertilizer dose 50% + Poultry manure, T9 Recommended fertilizer dose 50% + Vermicompost, T10 Recommended fertilizer dose 50% + Biofertilizers, T11 Recommended fertilizer dose 50% + Farmyard manure +Sheep manure + Poultry manure + Vermicompost +Biofertilizers, T12 Recommended fertilizer dose 75% + Farmyard manure, T13 Recommended fertilizer dose 75% + Sheep manure,

T14 Recommended fertilizer dose 75% + Poultry manure, T15 Recommended fertilizer dose 75% + Vermicompost, T16 Recommended fertilizer dose 75 % + Biofertilizers, T17 Recommended fertilizer dose 75% + Farmyard manure + Sheep manure + Poultry manure + Vermicompost + Biofertilizers, T18 Recommended fertilizer dose. Cultural operations were followed as per recommendations. Observations were recorded on various yield attributes, ten competitive plants were selected at random from each replication and tagged for recording observations. Mean values for all the characters were worked out.

The pH of soil was determined using pH meter having glass and calomel electrode using 1:2.5 soil: water suspension ratio (Jackson, 1973) [4] Electrical conductivity of soil was determined with the help of Systronic Conductivity Meterusing 1: 2.5 soil: water suspension ratio (Jackson, 1973) [4]. Organic carbon was determined by Walkley and Black wet digestion method (Black, 1965) [1].

Results and Discussion

Effect on yield

The pooled data presented in Table 1 revealed significantly higher values fruit yield per plot (15.62 kg), red ripe fruit yield per hectare (173.43 q) and dry fruit yield per hectare (55.65 q) was observed in treatment T17 (RFD 75% + Farmyard manure + Sheep manure + Poultry manure + Vermicompost + Biofertilizers). It can be attributed to its nutritional richness, quick mineralization, efficient microbial activity leading to sustainable nutrient availability and improvement in soil physical conditions. All these might have led to better root proliferation, better translocation of plant nutrients and accelerated carbohydrate synthesis finally leading to better yields. These results obtained in present study are in line with those of Harikrishna *et al*. 2002 [2] and Malik *et al*. 2009 [5].

Table 1: Effect of integrated nutrient management on fruit yield per plot (kg), fruit yield per hectare (q) and dry fruit yield per hectare (q) of chilli

Symbols	Treatments	Fruit yield per plot			Fruit yield per hectare			Dry fruit yield per hectare		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled
T1	Control	12.72	12.89	12.82	141.36	143.22	142.25	26.23	26.17	26.12
T2	Farmyard Manure	13.16	13.20	13.19	146.22	146.66	146.42	31.24	31.22	31.27
T3	Sheep Manure	13.26	13.29	13.29	147.33	147.64	147.47	34.12	34.22	34.25
T4	Poultry manure	13.33	13.36	13.36	148.12	148.43	148.25	35.76	35.50	35.25
T5	Vermicompost	13.23	13.25	13.25	146.97	147.21	147.12	33.16	33.39	33.22
T6	RFD 50% + Farmyard Manure	13.35	13.47	13.42	148.32	149.62	148.97	39.65	39.62	39.65
T7	RFD 50% + Sheep Manure	13.45	13.55	13.51	149.44	150.52	149.98	41.92	41.59	41.23
T8	T8 RFD 50%+ Poultry manure	13.57	13.62	13.58	150.75	151.32	151.11	42.86	42.87	42.81
T9	RFD 50% + Vermicompost	13.38	13.47	13.44	148.66	149.64	150.21	40.62	40.48	40.25
T10	RFD 50% + Biofertilizers	13.34	13.36	13.34	148.21	148.46	148.30	37.62	37.46	37.22
T11	RFD 50% + FYM + SM + PM + VC + BF	13.78	13.68	13.72	153.12	151.97	152.53	43.32	43.30	43.32
T12	RFD 75% + Farmyard Manure	13.86	13.72	13.78	153.99	152.44	153.21	44.52	44.35	44.24
T13	RFD 75% + Sheep Manure	14.10	14.00	14.10	156.68	155.54	156.12	47.24	47.21	47.22
T14	RFD 75% + Poultry manure	14.70	14.61	14.67	163.33	162.33	162.82	48.25	48.26	48.25
T15	RFD 75% + Vermicompost	13.92	13.80	13.87	154.67	153.33	153.97	46.23	46.25	46.25
T16	RFD 75% + Biofertilizers	13.70	13.64	13.66	152.22	151.55	151.86	42.24	42.19	42.12
T17	RFD 75% + FYM + SM + PM +VC + BF	15.66	15.56	15.62	173.96	172.89	173.43	55.98	55.80	55.65
T18	Recommended fertilizer dose	13.90	13.78	13.86	154.52	153.12	153.75	45.22	45.26	45.22
	CD ($p< 0.05$)	0.060	0.070	0.062	0.710	0.752	0.721	0.318	0.312	0.315

Effect on soil properties

The pooled data in Table 2 revealed significantly higher values of soil pH (6.782), electrical conductivity (0.124 d sm^{-1}) and organic carbon (1.504%) was observed in treatment T17 (RFD 75% + Farmyard manure +Sheep manure + Poultry manure + Vermicompost + Biofertilizers). Increase in soil pH might be due to acidifying effect of urea and organic acid produced during the course of decomposition of organic amendments. Similar results were obtained by Saravanan and Baskar (1996) [6]. However increase in electrical conductivity might be attributed to mining of the nutrients responsible for increasing pH of soil and also acidifying effect of urea and organic acid produced during the course of decomposition of organic amendments. Similar results were obtained by Tambe *et. al*. (2015) [7]. Increase in organic carbon may be due to non-addition of organic matter with inorganic sources.

Table 2: Effect of integrated nutrient management on organic carbon (%) and available nitrogen (kg per hectare)

Symbols	Treatments	Soil pH			Electrical conductivity			Organic carbon		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2014)	Kharief (2013)	Pooled	Kharief (2014)	Kharief (2013)	Pooled
T1	Control	6.506	6.499	6.511	0.104	0.105	0.101	1.022	1.280	1.164
T2	Farmyard Manure	6.535	6.532	6.520	0.102	0.105	0.103	1.063	1.342	1.184
T3	Sheep Manure	6.543	6.553	6.558	0.103	0.106	0.104	1.084	1.362	1.219
T4	Poultry manure	6.553	6.564	6.570	0.104	0.109	0.106	1.105	1.373	1.223
T5	Vermicompost	6.522	6.536	6.546	0.102	0.104	0.103	1.075	1.354	1.203
T6	RFD 50% + Farmyard Manure	6.593	6.607	6.571	0.105	0.111	0.107	1.133	1.454	1.257
T7	RFD 50% + Sheep Manure	6.616	6.626	6.633	0.107	0.113	0.111	1.153	1.455	1.307
T8	T8 RFD 50%+ Poultry manure	6.624	6.638	6.650	0.108	0.114	0.113	1.173	1.466	1.332
T9	RFD 50% + Vermicompost	6.573	6.585	6.596	0.104	0.110	0.110	1.145	1.438	1.286
T10	RFD 50% + Biofertilizers	6.633	6.645	6.636	0.109	0.115	0.107	1.126	1.408	1.264

T11	RFD 50% + FYM + SM + PM + VC + BF	6.714	6.726	6.692	0.114	0.120	0.116	1.257	1.537	1.368
T12	RFD 75% + Farmyard Manure	6.690	6.704	6.684	0.112	0.118	0.119	1.225	1.517	1.387
T13	RFD 75% + Sheep Manure	6.705	6.733	6.742	0.113	0.119	0.121	1.243	1.537	1.456
T14	RFD 75% + Poultry manure	6.724	6.743	6.751	0.115	0.121	0.123	1. 263	1.546	1.486
T15	RFD 75% + Vermicompost	6.703	6.723	6.719	0.111	0.117	0.118	1.233	1.525	1.427
T16	RFD 75% + Biofertilizers	6.731	6.753	6.702	0.117	0.122	0.120	1.213	1.505	1.419
T17	RFD 75% + FYM + SM + PM +VC + BF	6.749	6.762	6.782	0.118	0.125	0.124	1.284	1.554	1.504
T18	Recommended fertilizer dose	6.660	6.673	6.657	0.111	0.117	0.115	1.115	1.393	1.401
	CD ($p< 0.05$)	0.020	0.019	0.018	0.001	0.003	0.003	0.010	0.014	0.012

Conclusion

From the above investigation it could be proved that the treatment T17 (RFD 75% + Farmyard manure +Sheep manure + Poultry manure + Vermicompost + Biofertilizers) was found to be the best treatments for increasing yield of chilli as well as improving the properties. Thus, it may be concluded that integrated nutrient management practice was found beneficial for sustaining soil health in terms of buildup of organic carbon and enhancing the crop yield.

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