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Productivity of chilli (var. Kashmir long) as influenced by organic and inorganic nutrient management

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Abstract
A field experiment was conducted at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir during Kharif 2013 and Kharif 2014 with an objective to assess effectiveness of organic and inorganic nutrient package for enhancing growth and yield in chilli. The experiment was carried out in randomized block design with eighteen treatments i.e. organic, inorganic and combinations of organic and inorganic sources. The organic sources used were: Farmyard manure, Sheep manure, Poultry manure, Vermicompost, Biofertilizers and integrated with 50%, 75% and 100% recommended fertilizer dose in the form of chemical fertilizer. Results revealed that Treatment T14 (RFD 75% + Poultry manure) recorded significantly higher values for plant height (58.06), plant spread (53.77) and whereas T17 (RFD 75% + Farmyard manure + Sheep manure + Poultrymanure + Vermicompost + Biofertilizers) recorded significantly higher values for number of fruits per plant (58.42), fruit length (10.41 cm), fruit girth (1.92 cm), average fruit weight (7.92 g) and red ripe fruit yield per hectare (173.42 q). It also recorded lowest days to 50% maturity of fruits (96.92 days).

Keywords: Chilli, organic, inorganic nutrient management

Introduction
S Chilli (*Capsicum annuum* L.) popularly known as "King of spices" is one of the important commercial crop of India. It is used in food and beverage industries for its oleoresin which imparts characteristic colour and flavour to food. Hence, chilli finds diverse utility as a spice, condiment, culinary supplement and vegetable. Being a long duration crop, requires proper manuring and fertilizing in the surface soil is because of its shallow root system, for attaining high yields and quality produce (Bidari, 2000) [2]. Among various factors responsible for low production of chilli, nutrient management is of prime importance for maintaining higher yield and soil fertility. It has been reported that neither the chemical fertilizer alone nor the organic manure are able to sustain the crop productivity and soil fertility. The increasing use of chemical fertilizers to increase vegetable production has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental which affect living organisms including beneficial soil microorganism and human being. The escalating prices of chemical fertilizers and its detrimental impact on the soil, environment and human health urged the farmer to adoption of integrated plant nutrient that offers the sustainable crop production and soil fertility (Sentiyangla *et al*., 2010) [7]. Besides fertilizers, there are several sources of plant nutrients like organic manures, biofertilizers etc. These nutrients sources not only reduce quantity of chemical fertilizers but also improve soil fertility (Chumyani *et al*., 2012) [3]. Use of organic manures in INM help mitigating multiple nutrient deficiencies. Application of organic manures provides better environment for growth and development and in addition improves physical, chemical and biological properties of soil (Avitoli *et al*., 2012) [1]. Therefore the present investigation was undertaken to study the effect of organic, inorganic and biofertilizers for growth and yield improvement in chillies.

Material and Methods
A field experiment was conducted at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir during Kharif 2013 and Kharif 2014. The experiment was laid out in randomized block design, with eighteen treatments replicated thrice. Treatments were as follows:
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 + Poultrymanure + 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 dose75 % + Biofertilizers
T17: Recommended fertilizer dose 75% + Farmyard manure +Sheep manure + Poultry manure + Vermicompost + Biofertilizers
T18: Recommended fertilizer dose

The crop was raised with a spacing of 30cm x 45cm.Standard recommended cultural practices were followed and fertilizers were applied as per treatments. Biofertilizers Azotobacter and Phosphorus solubilizing bacteria @ 2.5 kg ha^{-1} each was applied as soil application. Data on growth characters, yield attributes and yield were recorded. Growth parameters presented in (Table 1) revealed that among sole application of organic treatment T4 (Poultry manure) recorded highest values of 51.00 cm, 45.97 cm for plant height and plant spread respectively followed by T3 (Sheep manure) and T5 (Vermicompost). However pooled data revealed that maximum value for plant height (58.06 cm), plant spread (53.77 cm) was observed in T14 (RFD 75% + Poultry manure) followed by T17 (RFD 75% + Farmyard manure + Sheep manure + Poultry manure + Vermicompost + Biofertilizers) These results are in line with Jose *et al*. 1988. The data presented in Table 2, 3 and 4 revealed that among sole application of organic manures T4 (Poultry manure) recorded highest values for number of fruits per plant (52.91), fruit length (8.11 cm), fruit girth (1.73 cm) average fruit weight (6.89 g), red ripe fruit yield per hectare (148.25 q) and lower value for days to 50 per cent fruit maturity (92.06) followed by T3 (Sheep manure) and T5 (Vermicompost). However pooled data revealed higher values for number of fruits per plant (58.42), fruit length (10.41cm), fruit girth (1.94 cm) average fruit weight (7.92 g), red ripe fruit yield per hectare (173.43 q) and lower value for days to 50 per cent fruit maturity (85.92) was observed in treatment T17 (RFD 75% + Farmyard manure + Sheep manure + Poultry manure + Vermicompost + Biofertilizers). These results obtained in present study are in line with those of Harikrishna *et al*. 2002 [4] and Malik *et al*. 2009 [6].

Table 1: Effect of Integrated nutrient management on plant height and plant spread of chilli

Symbols	Treatments	Plant height			Plant spread		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled
T1	Control	49.79	49.54	49.42	44.10	44.65	44.31
T2	Farmyard Manure	50.14	50.00	50.12	45.09	45.15	45.10
T3	Sheep Manure	50.85	50.34	50.40	45.16	45.53	45.24
T4	Poultry manure	51.42	51.00	51.00	45.91	46.00	45.97
T5	Vermicompost	51.02	50.71	50.64	45.88	45.82	45.80
T6	RFD 50% + Farmyard Manure	51.77	51.24	51.62	46.65	46.45	46.45
T7	RFD 50% + Sheep Manure	52.68	52.00	52.22	47.05	46.95	47.12
T8	RFD 50%+ Poultry manure	53.02	52.32	52.70	47.40	47.12	47.36
T9	RFD 50% + Vermicompost	52.17	51.70	52.09	46.95	46.80	46.86
T10	RFD 50% + Biofertilizers	51.32	51.00	51.42	46.35	46.25	46.15
T11	RFD 50% + FYM + SM + PM + VC + BF	55.09	54.76	54.70	48.34	48.32	48.13
T12	RFD 75% + Farmyard Manure	55.13	54.85	54.87	50.70	49.84	49.87
T13	RFD 75% + Sheep Manure	56.46	56.23	56.33	52.57	51.68	52.14
T14	RFD 75% + Poultry manure	58.00	58.12	58.06	54.00	53.64	53.77
T15	RFD 75% + Vermicompost	55.78	55.20	55.34	51.88	50.68	51.42
T16	RFD 75% + Biofertilizers	53.54	52.75	53.18	47.89	47.50	47.59
T17	RFD 75% + FYM + SM + PM +VC + BF	57.18	57.21	57.11	53.10	52.40	52.70
T18	Recommended fertilizer dose	54.75	54.12	54.22	48.62	48.52	48.47
	CD ($p< 0.05$)	0.260	0.240	0.250	0.170	0.186	0.166

Table 2: Effect of Integrated nutrient management on number of fruits per plant and days to 50% maturity of fruit of chilli

Symbols	Treatments	Number of fruits per plant			Days to 50% maturity of fruit		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled
T1	Control	50.60	50.00	50.32	93.52	93.66	93.58
T2	Farmyard Manure	52.22	52.36	52.29	93.25	93.14	93.17
T3	Sheep Manure	52.55	52.86	52.72	92.69	92.25	92.45
T4	Poultry manure	52.89	52.92	52.91	92.09	91.99	92.06
T5	Vermicompost	52.30	52.47	52.37	92.75	92.88	92.82
T6	RFD 50% + Farmyard Manure	53.12	53.46	53.30	91.32	91.62	91.96
T7	RFD 50% + Sheep Manure	53.42	53.72	53.58	90.22	90.87	91.35
T8	T8 RFD 50%+ Poultry manure	53.50	53.81	53.66	91.30	91.52	91.42
T9	RFD 50% + Vermicompost	53.22	53.51	53.37	92.24	91.49	91.88
T10	RFD 50% + Biofertilizers	53.00	53.02	53.00	92.02	91.79	92.12
T11	RFD 50% + FYM + SM + PM + VC + BF	54.22	54.40	54.33	90.29	90.45	90.85
T12	RFD 75% + Farmyard Manure	54.32	54.71	54.53	90.12	90.21	90.08

T13	RFD 75% + Sheep Manure	55.58	55.43	55.51	89.20	88.89	89.05
T14	RFD 75% + Poultry manure	56.23	56.00	56.14	86.49	86.89	86.68
T15	RFD 75% + Vermicompost	54.91	55.12	55.05	89.59	89.35	89.46
T16	RFD 75% + Biofertilizers	53.88	54.10	53.98	90.72	90.65	90.67
T17	RFD 75% + FYM + SM + PM +VC + BF	58.27	58.54	58.42	85.70	86.19	85.92
T18	Recommended fertilizer dose	54.72	54.89	54.77	89.98	89.72	89.85
	CD ($p< 0.05$)	0.160	0.153	0.131	0.130	0.190	0.163

Table 3: Effect of Integrated nutrient management on fruit length (cm) and fruit girth (cm) of chilli

Symbols	Treatments	Fruit length (cm)			Fruit girth (cm)		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled
T1	Control	7.32	7.52	7.43	1.67	1.65	1.67
T2	Farmyard Manure	7.90	7.80	7.87	1.70	1.69	1.69
T3	Sheep Manure	7.90	8.10	8.00	1.73	1.70	1.71
T4	Poultry manure	8.00	8.13	8.11	1.75	1.72	1.73
T5	Vermicompost	7.98	7.82	7.92	1.71	1.69	1.70
T6	RFD 50% + Farmyard Manure	8.30	8.26	8.29	1.77	1.76	1.76
T7	RFD 50% + Sheep Manure	8.42	8.52	8.49	1.79	1.78	1.79
T8	RFD 50%+ Poultry manure	8.58	8.60	8.60	1.80	1.79	1.80
T9	RFD 50% + Vermicompost	8.32	8.31	8.32	8.60	1.77	1.76
T10	RFD 50% + Biofertilizers	8.05	8.12	8.09	1.76	1.74	1.75
T11	RFD 50% + FYM + SM + PM + VC + BF	9.12	8.80	8.97	1.83	1.82	1.83
T12	RFD 75% + Farmyard Manure	9.18	8.98	9.09	1.85	1.83	1.85
T13	RFD 75% + Sheep Manure	9.86	9.45	9.67	1.91	1.92	1.91
T14	RFD 75% + Poultry manure	10.17	9.56	9.87	1.94	1.95	1.94
T15	RFD 75% + Vermicompost	9.10	9.35	9.24	1.87	1.85	1.86
T16	RFD 75% + Biofertilizers	8.87	8.76	8.82	1.81	1.80	1.82
T17	RFD 75% + FYM + SM + PM +VC + BF	10.56	10.25	10.41	1.92	1.93	1.92
T18	Recommended fertilizer dose	9.20	9.00	9.10	1.90	1.91	1.90
	CD ($p< 0.05$)	0.100	0.110	0.102	0.016	0.020	0.017

Table 4: Effect of Integrated nutrient management on average fruit weight (g) and fruit yield per hectare (q) of chilli

Symbols	Treatments	Average fruit weight (g)			Fruit yield per hectare (q)		
		Kharief (2013)	Kharief (2014)	Pooled	Kharief (2013)	Kharief (2014)	Pooled
T1	Control	6.71	6.61	6.67	141.36	143.22	142.25
T2	Farmyard Manure	6.84	6.82	6.84	146.22	146.66	146.42
T3	Sheep Manure	6.87	6.86	6.87	147.33	147.64	147.47
T4	Poultry manure	6.89	6.87	6.89	148.12	148.43	148.25
T5	Vermicompost	6.86	6.85	6.86	146.97	147.21	147.12
T6	RFD 50% + Farmyard Manure	6.93	6.96	6.93	148.32	149.62	148.97
T7	RFD 50% + Sheep Manure	6.96	6.99	6.96	149.44	150.52	149.98
T8	T8 RFD 50%+ Poultry manure	6.98	7.00	6.98	150.75	151.32	151.11
T9	RFD 50% + Vermicompost	6.94	6.97	6.95	148.66	149.64	150.21
T10	RFD 50% + Biofertilizers	6.92	6.94	6.93	148.21	148.46	148.30
T11	RFD 50% + FYM + SM + PM + VC + BF	7.07	7.10	7.10	153.12	151.97	152.53
T12	RFD 75% + Farmyard Manure	7.09	7.10	7.15	153.99	152.44	153.21
T13	RFD 75% + Sheep Manure	7.24	7.35	7.30	156.68	155.54	156.12
T14	RFD 75% + Poultry manure	7.57	7.65	7.62	163.33	162.33	162.82
T15	RFD 75% + Vermicompost	7.12	7.22	7.19	154.67	153.33	153.97
T16	RFD 75% + Biofertilizers	7.00	7.12	7.07	152.22	151.55	151.86
T17	RFD 75% + FYM + SM + PM +VC + BF	7.93	7.88	7.92	173.96	172.89	173.43
T18	Recommended fertilizer dose	7.10	7.16	7.13	154.52	153.12	153.75
	CD ($p< 0.05$)	0.060	0.050	0.060	0.710	0.752	0.721

Thus the present study revealed that integration of organic manures with inorganic fertilizers (75%) exhibited superiority over sole application of organics and inorganics with respect to almost all the characters of the main crop and soil health under study. Long-term experimentation may be necessary to elucidate beneficial effects of the organics, especially, on aspects relating to soil health. Nonetheless, a gradual shift away from the chemical to organic practices seems a prudent choice for sustained crop production and the superior quality of produce.

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