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Quality of Chillies (*Capsicum annuum* L.) as Influenced by Organic Manures Application

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A B S T R A C T

Application of organic fertilizers contributes to sustainability of agricultural systems. Two field experiments were conducted during 2010 - 12 at Agricultural College & Research Institute, Killikulam, Tamil Nadu to study the response of organic manures and their time of application on yield and quality of chillies. The field experiments were conducted in split plot design with different sources of organic manures (FYM, Vermicompost and FYM +Vermicompost) and time of application of organic manures (All basal, 2, 3 and 4 splits). Pooled analysis of data revealed that, among the sources of organic manures, vermicompost (VC) 100% application recorded the highest capsaicin (0.63%), oleoresin (14.0%), ascorbic acid (140 mg/100g) and colour value (303 ASTA units) of chillies. Application of organic manures in 4 splits registered the highest capsaicin (0.63%), oleoresin (14.0%), ascorbic acid (145 mg/100g) and colour value (297 ASTA units). While comparing organic and inorganic sources, application of organic manures recorded higher values with respect to quality parameters when compared to inorganic fertilizers application. Hence, vermicompost 100% application on N equivalent basis in four equal splits can be adopted to get best quality of chillies under organic farming.

Introduction

Chillies (C*apsicum annnum* L.), a member of the family Solanaceae is an important commercial spice cum vegetable crop of India. There is no spice probably so popular as chilli and no other spice has become such an indispensable ingredient of the daily food of majority people of the world. The area under chillies in India is 805 thousand hectares with a production of 1276 thousand tonnes during the year 2011-12 (Anonymous, 2013). Both green and dried chillies are the important components of our routine diet which give the required pungency, colour, taste and flavour to our dishes. The presence of capsaicin in chilli is responsible for its pungency and it has medicinal value. There is lot of demand for chilli oleoresin in the world market. It is having lot of export potential. Chilli is a rich source of vitamin 'C' and 'A' with plenty of minerals. The principal colouring matter is capsanthin, the carotenoid pigment which contributes about 35 per cent to the total pigments.

Consequent upon Green Revolution, the use of high yielding and fertilizer responsive varieties and cultivation system has been intensified and this prompted the use of chemical fertilizers and pesticides. Indiscriminate use of chemical fertilizers and pesticides led to several harmful effects on soil, water and environment causing their pollution and decline in the productivity of the soil. Organic farming helps in rejuvenating the degraded soil and ensure sustainability of crop production. Global awareness of health and environmental issues is increasing in recent years and the demand for organic agricultural products is increasing day by day. Moreover, they are ready to pay a premium price for such foods.

Chilli being a major spice with tremendous export potential, the emphasis needs to be given for increasing the quality apart from productivity and both can be achieved by optimum and balanced supply of all the plant required nutrients. Application of FYM improves quality of chilli by enhancing ascorbic acid content (Chavan *et al.*, 1997), oleoresin content (Malawadi, 2003) and colour value. Jayasree (2006) observed an improvement in quality of chilli due to Panchagavya spray. In this context, it is felt that organic nutrition is a remedy to manage the ill effects of chemical farming so as to manage soil health for sustaining the soil productivity and quality of chilli. In the light of the above facts, the present investigation was conducted to study the effect of organic manures and their time of application on quality of chillies (*Capsicum annuum* L.) under organic farming.

Materials and Methods

Two field experiments were conducted during the season Sep-Oct of 2010-11 and 2011-12 at Agricultural College &Research Institute, Killikulam, Tamil Nadu with chillies var. KKM1 as test crop. The field experiments were conducted in split plot design and replicated thrice. The different sources of organic manures (FYM, Vermicompost and FYM + Vermicompost) were taken in main plot. Time of application of organic manures (All basal, 2, 3 and 4 splits) was taken as sub-plot treatments. The second field experiment was conducted in the same field and in the same plots as continuous experiment.

The treatments Blanket recommendation (T_{13}), STCR - IPNS recommendation (T_{14}) and absolute control (T_{15}) were raised in adjacent field of same soil type as the inorganic treatments should not be mixed with organic plots. The soil of the experimental field was sandy clay in texture with pH of 7.45, EC of 0.26 dSm^{-1} and organic carbon content of 0.52 %. The available N, P and K values of the initial soil are 247, 21.8 and 302 kg ha^{-1} respectively. For inorganic treatments, the available N, P and K values of the initial soil are 242, 19.6 and 339 kg ha^{-1} respectively for field experiment I and 261, 21.7 and 347 kg ha^{-1} respectively for field experiment II.

Based on the initial soil test values, the manures and fertilizers recommendation for STCR-IPNS treatment for a yield target of 25 q ha^{-1} was calculated using the following fertilizer prescription equations. The fertilizer doses after adjusting the contributions through FYM@ 25 t ha^{-1} were 60:36:16 kg ha^{-1} $N:P_2O_5:K_2O$ and 60:30:15 kg ha^{-1} $N:P_2O_5:K_2O$ respectively for the field experiments I and II. The fertilizer prescription equations followed for STCR-IPNS treatments in chillies (red soil) is as follows.

$FN = 8.29\ T - 0.32\ SN$; $FP_2O_5 = 7.13\ T - 5.24\ SP$; $FK_2O = 5.86\ T - 0.15\ SK$

Where, FN - Fertilizer N supplied in kg ha^{-1}; F P_2O_5 - Fertilizer P_2O_5 supplied in kg ha^{-1}; FK_2O - Fertilizer K_2O supplied in kg ha^{-1};T -

Yield target in Q ha^{-1}; SN – Soil available N in kg ha^{-1}; SP – Soil available P in kg ha^{-1}; SK – Soil available K in kg ha^{-1}

Being organic chilli, organic farming practices were followed. The total N, P and K content of FYM and Vermicompost were analysed and the values given in Table 1. The organic manures were applied on N equivalent basis (120 kg N ha^{-1}) as basal and on 30, 60 and 90 days after planting as per the treatment schedule. Ascorbic acid content was analyzed in matured fresh green chillies selected at random from each treatment (Sadasivam and Manickam, 2005).

The capsaicin, oleoresin and colour value were determined in the representative composite samples of sundried red chilli fruits collected from each treatment as per the methods suggested by Sadasivam and Manickam (2005). Data from two field experiments and pooled mean were analysed statistically as per Gomez and Gomez (1984). The treatments $T_{13,}$ T_{14} and T_{15} (inorganic treatments) were not included in statistical analysis and the mean values were used for comparison with organic manures application.

Results and Discussion

The pooled analysis of the data revealed that, among the sources of organic manures, vermicompost (VC) 100% application recorded the highest capsaicin (0.63%), oleoresin (14.0%), ascorbic acid (140 mg/100g) and colour value (303 ASTA units) followed by FYM 50% + VC50% and FYM 100% (Tables 2 to 5). Vermicompost performed better than FYM which may be due to the higher nutrient content and also the presence of many plant growth hormones and beneficial microorganisms in vermicompost (Barik and Gulati, 2009).

Shashidhara *et al*. (2007) reported substantial increase in ascorbic acid content of chilli (*Capsicum annuum* L.) with the application of organics. Similar increase in ascorbic acid content due to application of organics in chilli was reported by Das and Mishra (1972). Chavan *et al*. (1997) opined that the increased content of ascorbic acid due to better nutrient availability and nutrient uptake. Nanthakumar and Veeraragavathatham (2001) recorded significantly higher ascorbic acid content over control due to application of crop residues.

Application of organic manures in 4 splits registered the highest capsaicin (0.63%), oleoresin (14.0%), ascorbic acid (145 mg/100g) and colour value (297 ASTA units) followed by 3 split application which were on par (Tables 2 to 5). This might be due to the reason that with increasing number of splits, the nutrients are made available throughout the crop growth period. The study conducted by Ahmad et al. (2007) revealed that the rate of mineralization (process by which nutrients are released from the manures) of N enriched compost increases sharply up to 10 days of incubation and then it becomes constant. Higher uptake of nutrients led to enhanced synthesis of volatile oil in seeds and pericarp resulting in enhanced oleoresin yield (Kanner, *et al*., 1997).

Table.1 Nutrient content of organic manures used in the experiments

Nutrient	FYM	Vermicompost
Total N %	0.50	1.20
Total P %	0.16	0.61
Total K %	0.32	0.74

Table.2 Capsaicin (%) as influenced by sources and time of application of organic manures

Treatments	Field Experiment I				Field Experiment II				Pooled mean			
	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean
All basal	0.51	0.58	0.56	**0.55**	0.53	0.61	0.59	**0.58**	0.52	0.59	0.58	0.56
2 splits	0.52	0.59	0.57	**0.56**	0.55	0.63	0.60	**0.59**	0.54	0.61	0.58	0.58
3 splits	0.56	0.61	0.58	**0.59**	0.59	0.66	0.62	**0.62**	0.58	0.64	0.60	0.61
4 splits	0.58	0.66	0.60	**0.61**	0.61	0.70	0.63	**0.65**	0.59	0.68	0.61	0.63
Mean	**0.54**	**0.61**	**0.58**		**0.57**	**0.65**	**0.61**		0.56	0.63	0.60	
	SEd		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**	
M	0.01		0.03		0.01		0.04		0.01		0.04	
S	0.02		0.04		0.02		0.04		0.02		0.04	
M at S	0.03		NS		0.03		NS		0.03		NS	
S at M	0.03		NS		0.03		NS		0.03		NS	

Table.2a Capsaicin (%) as influenced by inorganic fertilizers

Treatments	Field Experiment I	Field Experiment II	Pooled mean
Blanket recommendation	0.53	0.54	0.54
STCR - IPNS recommendation	0.56	0.57	0.57
Absolute control	0.45	0.44	0.45

Table.3 Oleoresin (%) as influenced by sources and time of application of organic manures

Treatments	Field Experiment I				Field Experiment II				Pooled mean			
	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean
All basal	12.1	13.2	12.5	**12.6**	12.4	13.6	12.7	**12.9**	12.3	13.4	12.6	12.8
2 splits	12.2	13.9	13.1	**13.1**	12.5	14.2	13.5	**13.4**	12.4	14.0	13.3	13.2
3 splits	13.1	14.1	13.5	**13.6**	13.5	14.5	13.9	**14.0**	13.3	14.3	13.7	13.8
4 splits	13.3	14.2	13.9	**13.8**	13.7	14.6	14.2	**14.2**	13.5	14.4	14.1	14.0
Mean	**12.7**	**13.9**	**13.2**		**13.0**	**14.2**	**13.6**		12.8	14.0	13.4	
	SEd		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**	
M	0.3		0.8		0.3		0.8		0.3		0.8	
S	0.4		NS		0.5		1.0		0.5		0.9	
M at S	0.7		NS		0.7		NS		0.7		NS	
S at M	0.7		NS		0.8		NS		0.8		NS	

Table.3a Oleoresin (%) as influenced by inorganic fertilizers

Treatments	Field Experiment I	Field Experiment II	Pooled mean
Blanket recommendation	13.1	13.2	13.2
STCR - IPNS recommendation	13.4	13.5	13.5
Absolute control	12.2	12.3	12.2

Table.4 Ascorbic acid (mg/100g) as influenced by sources and time of application of organic manures

Treatments	Field Experiment I				Field Experiment II				Pooled mean			
	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean
All basal	112	121	117	**117**	119	129	124	**124**	116	125	121	120
2 splits	119	125	122	**122**	125	135	131	**130**	122	130	127	126
3 splits	133	139	135	**136**	139	148	146	**144**	136	144	141	140
4 splits	123	158	142	**141**	131	167	151	**150**	127	163	147	145
Mean	**122**	**136**	**129**		**129**	**145**	**138**		125	140	134	
	SEd		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**	
M	3		8		3		9		3		8	
S	4		9		5		10		5		10	
M at S	7		NS		8		NS		7		NS	
S at M	8		NS		7		NS		8		NS	

Table.4a Ascorbic acid (mg/100g) as influenced by inorganic fertilizers

Treatments	Field Experiment I	Field Experiment II	Pooled mean
Blanket recommendation	115	121	118
STCR - IPNS recommendation	121	132	127
Absolute control	100	103	102

Table.5 Colour Value (ASTA units) as influenced by sources and time of application of organic manures

Treatments	Field Experiment I				Field Experiment II				Pooled mean			
	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean	FYM	VC	FYM + VC	Mean
All basal	243	286	265	**265**	249	294	271	**271**	246	290	268	268
2 splits	255	295	277	**276**	262	304	284	**283**	259	300	281	280
3 splits	263	302	288	**284**	271	312	293	**292**	267	307	291	288
4 splits	278	308	293	**293**	285	319	301	**302**	282	314	297	297
Mean	**260**	**298**	**281**		**267**	**307**	**287**		263	303	284	
	SEd		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**		**SEd**		**CD(P=0.05)**	
M	6		16		6		17		6		17	
S	9		20		10		20		9		20	
M at S	15		NS		16		NS		15		NS	
S at M	16		NS		15		NS		16		NS	

Table.5a Colour Value (ASTA units) as influenced by inorganic fertilizers

Treatments	Field Experiment I	Field Experiment II	Pooled mean
Blanket recommendation	249	255	252
STCR - IPNS recommendation	265	274	270
Absolute control	223	227	225

Application of organic manures recorded higher values with respect to quality parameters when compared to inorganic fertilizers application (Tables 2a to 5a). While comparing organic and inorganic sources, quality of chillies (capsaicin - 0.57%, oleoresin - 13.5%, ascorbic acid - 127 mg/100g and colour value - 270 ASTA units with inorganics application) was higher with organic manures application. Shashidhara *et al*. (2007) observed increased oleoresin content of chillies with the application of organic manures when compared to the application of recommended dose of fertilizers. Vijayakumari *et al.*, (2007) reported enhanced carotenoid and β-carotene content with the application of FYM over inorganic fertilizers application. Hence, vermicompost 100% application on N equivalent basis in four equal splits can be adopted to get higher quality of chillies under organic farming.

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