Journal Crop and Weed, 11(Special Issue):28-33(2015)

Effect of planting date and integrated nutrient management on the production potential of tomato (*Solanum lycopersicon* Mill.) under polyhouse condition

A. SINGH, P. K. JAIN, H. L. SHARMA AND Y. SINGH

College of Agriculture, Department of Horticulture,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004 (MP)

Received:21-07-2014; Revised: 02-11-2014; Accepted:12-11-2014

ABSTRACT

An experiment was conducted to assess the different date of planting viz; September 15 (D1), September 30 (D2) and October 15 (D3) and different sources of organic and inorganic fertilizers. The result revealed that the growth parameters and yield attributing traits were significantly influenced by different planting dates and sources of nutrients. Planting on September 15 (D1) recorded the highest plant height (254.95 cm),number of leaves per plant (33.47), fruits per plant (80.39), fruit length (6.75 cm), fruit girth (5.53 cm), mean fruit weight (124.26 g), yield per plant (10.39 kg),yield per plot (42.44 kg) and TSS (5.55 ºB) content over later date of planting. The plants treated with 50% RDF +10 t ha FYM + 5 t ha poultry manure + biofertilizer showed maximum number of leaves per plant (36.88), fruits per plant (74.69), fruit length (6.85 cm), mean fruit weight (134.33 g), yield per plant (10.77 kg), yield per plot (38.90 kg) and ascorbic acid content (40.02 mg/100g) over treatment having 100% RDF alone. Among interaction the plants planted on 15th September along with 50% RDF +10 t haFYM + 5 t haPoultry manure + biofertilizer resulted better yield and quality traits.

Keywords: *Nutrients, planting date, quality, tomato, yield*

The basic concept underlying the principles is the maintenance and improvement of soil fertility for sustaining crop productivity on a long-term basis, which can be achieved through the combined use of various sources of nutrients and by managing them scientifically along with optimum time of planting for optimum growth, yield and quality of crop. Tomato is one of the most important vegetable grown under open as well as protected condition throughout the world. In India area under tomato cultivation is 8.80 lakh hectares with a total production of 182.26 MT and productivity of 20.7 $mt.ha^{-1}$(Annonymous, 2013).Cultivation of tomato under open field conditions is limited due to prevailing of low temperature and frost injury during winter. To make their cultivation successful in winter and spring summer season, poly-house is a vital solution. In the recent years, there has been reduction in usage of organic manure and increase in the use of inorganic fertilizers to obtain higher yields from hybrids and improved varieties. Tomato being a heavy feeder and exhaustive crop responds very well to nutrients application. Use of chemical fertilizer alone increased the crop yield in the initial year but adversely affected the sustainability subsequently. The cost of chemical fertilizers is also increasing day by day. Therefore, to reduce dependence on chemical fertilizers along with sustainable production are vital issues in modern agriculture which can be achieved possible through integrated nutrient supply. On the other hand, organic manures like FYM, poultry manure and pig manure are cheap and easily available in local condition and can be efficiently utilized for tomato production. Integrated nutrient sources increase the nutrient use efficiently and soil fertility thus enhance the productivity of tomato. However, very limited information is available about cultivation of tomato crop under poly house condition along with date of planting and integrated nutrient management. In view of the above, the present investigation was conducted to study the effect of planting date and integrated nutrient levels on the production potential of tomato under poly house condition

Email: aradhanar_285@rediffmail.com

MATERIALS AND METHODS

The study was conducted in a poly house at the vegetable research farm, Maharajpur, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India during August 2013 to April 2014. Jabalpur is situated at latitude of 23.91^0 N and longitude of 79.5^0 E. The altitude of the place is 411.78 meters above the mean sea level. The climate of the region is typically semi-arid and sub-tropical having extreme winter and summer. The experiment was laid out in completely randomized design with factorial

concept in three replications consisting of different date of planting *viz*., 15th September, 30th September and 15th October and different sources of nutrients consisting of organic, inorganic and biofertilizers *i.e.* T_1-100% RDF + 10 t ha^{-1} FYM + 3 t ha^{-1} vermicompost, T_2-100% RDF + 10 t ha^{-1} FYM + 3 t ha^{-1} vermicompost + biofertilizers (PSB and *Azotobactor* @ 5kg ha^{-1}),T_3-100% RDF + 10 t ha^{-1} FYM + 2.5 t ha^{-1} poultry manure, T_4-100% RDF + 10 t ha^{-1} FYM + 2.5 t ha^{-1} poultry manure + biofertilizers, T_5-75% RDF + 10 t ha^{-1} FYM + 4.5 t ha^{-1} vermicompost, T_6-75% RDF + 10 t ha^{-1} FYM + 4.5 t ha^{-1} vermicompost + biofertilizers, T_7-75% RDF + 10 t ha^{-1} FYM + 3.75 t ha^{-1} poultry manure, T_8-75% RDF +10 t ha^{-1} FYM + 3.75 t ha^{-1} poultry manure + biofertilizers,T_9-50% RDF + 10t ha^{-1} FYM + 6 t ha^{-1} vermicompost, T_{10}-50% RDF + 10t ha^{-1} FYM + 6 t ha^{-1} vermicompost + biofertilizers, T_{11}-50% RDF + 10 t ha^{-1} FYM+ 5t ha^{-1} poultry manure, T_{12}-50% RDF +10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure + biofertilizers and T_{13}-100% RDF (200:100:100 NPK kg ha^{-1}).The hybrid seeds of tomato variety Katrina (Rashi Seeds) were used in the experiment.

Full dose of organic manures were applied before one week of transplanting. NPK was supplied through Urea, SSP and MOP. Full dose of P, K and half dose of N was applied at the time of transplanting and remaining half of N was applied 30 days after transplanting. Bio fertilizers (Azotobactor and PSB) were inoculated before transplanting as seedling root dip for 30 minutes @ 5 kg ha^{-1} each. One month old seedlings were transplanted in plots that measured 2.4 × 1.0 m at spacing of 60x60 cm. The crop was irrigated as required depending on the moisture status of the soil and requirement of plants. Observation were recorded for plant height, number of leaves plant^{-1}, fruit length, fruit diameter, number of fruits plant^{-1}, mean fruit weight, yield plant^{-1} and hectare^{-1}, total soluble solid and vitamin C content. Total soluble solid was determined using hand refractro meter and results expressed in °brix. Vitamin C content was determined by 2, 6-dichlorophenol indophenols visual titration method and expressed in mg 100^{-1} g as prescribed by A.O.A.C. (Anon, 1980).

RESULTS AND DISCUSSION

As per the results shown in table 1, 2 and 3 the two factors significantly affected the response measurements either individually (main effects) or combined effects (interaction). Planting time and nutrient sources showed significant variation with all the growth, yield and quality characters individually. The interaction effect of different planting dates and nutrient sources was significant on number of leaves plant^{-1}, days to 50% flowering, fruits plant^{-1}, fruit length, fruit weight, yield plant^{-1}, TSS and ascorbic acid content.

Effects on growth characters

Improvement in growth characters is considered to be pre-requisite to increased yield of any crop. The highest plant height of (254.95cm) and number of leaves per plant (33.47) was obtained from 15th September transplanted plants, which decreased significantly with each successive delay in planting time. Moreover, the maximum leaf area index (2.1) was observed in planting date D2 (30th September) followed by D1 (15th September). It is therefore evident that planting at 15th September and 30th September had induced normal vegetative growth, whereas the later dates were unfavorable for normal growth. The trend of present result is in agreement with the finding of Kadam *et al.* (1990) who also observed that conductive climatic conditions, particularly the higher temperature and optimum rainfall resulted in greater photosynthesis and higher mobilization of assimilates. The findings are also in agreement with the findings of Islam *et al.* (2010) reported that optimum sowing dates and spacing of crop ensures maximum number of leaves per plant. Hamma *et al.* (2012) observed that earlier planting date performed better in terms of growth because the crop gets enough duration to complete the vegetative phase fully.

The main effect of fertilizers levels in the result indicated that the treatment having 100% RDF + 10t ha^{-1} FYM + 2.5 t ha^{-1} poultry manure + biofertilizer (T4) recorded significantly maximum plant height. While the minimum was obtained in treatment having 100% RDF alone *i.e.* 200:100:100 NPK kg ha^{-1} (T13). Application of different levels of fertilizers, organic manures and biofertilizers either alone or in combination significantly increased the growth of tomato. Similar results have been reported by Brahma *et al.* (2009). Khan *et al.* (2012) obtained maximum growth in chilli by application of 100% recommended dose of N fertilizer + 15 t haFYM + biofertilizers. The maximum number of leaves per plant (36.88) and leaf area index (2.42) was recorded under treatment T12. Similar results were obtained by Yeptho *et al.* (2012) recorded that application of 50% NPK + 50% poultry manure + biofertilizers recorded maximum number of leaves plant^{-1} (58.19), Malawadi (2003) observed greater leaf area index by combined application of organic and inorganic, than inorganic alone. This clearly indicates the importance of adding organic manures and bio

Table 1: Influence of planting dates on growth, yield and quality of tomato

Date of planting	Plant height (cm)	No. of leaves plant^{-1}	Days to 50% flowering	Leaf area index (LAI)	Fruits plant^{-1}	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield Plant^{-1} (kg)	Yield plot $^{-1}$ (kg)	TSS (^{0}Brix)	Ascorbic acid content (mg 100^{-1} g)
15th September	254.95	33.47	42.64	2.06	80.39	6.75	5.53	124.26	10.39	42.44	5.55	28.28
30th September	243.43	32.55	42.02	2.10	61.00	6.40	5.35	108.06	6.64	33.96	5.40	34.59
15th October	252.04	28.29	40.56	1.21	37.25	6.21	5.12	100.63	4.68	24.59	5.28	27.49
SEM (±)	**1.85**	**0.22**	**0.21**	**0.05**	**2.77**	**0.07**	**0.04**	**1.46**	**0.34**	**0.69**	**0.03**	**0.61**
LSD (0.05)	**5.20**	**0.61**	**0.60**	**0.14**	**7.79**	**0.19**	**0.12**	**4.14**	**0.95**	**1.94**	**0.08**	**1.73**

Table 2: Influence of nutrient levels on growth, yield and quality of tomato

Nutrient levels	Plant height (cm)	No. of leaves plant^{-1}	Days to 50% flowering	LAI	Fruits plant^{-1}	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield (kg plant^{-1})	Yield plot $^{-1}$ (kg)	TSS (^{0}Brix)	Ascorbic acid content (mg 100^{-1} g)
T_1: 100% RDF + 10 t ha^{-1} FYM + 3 t ha^{-1} VC	246.88	26.97	39.17	1.23	68.98	6.39	5.40	108.75	7.77	29.54	5.04	23.14
T_2: T_1 + Biofertilizer	256.64	29.05	40.26	1.29	56.95	6.31	5.40	99.93	5.75	29.76	5.17	26.33
T_3: 100% RDF + 10 t ha^{-1} FYM + 2.5 t ha^{-1} PM	254.80	30.10	39.72	1.72	53.57	6.43	5.22	109.67	6.62	32.76	5.28	25.48
T_4: T_3 + Biofertilizer	26230	31.83	40.89	1.75	53.80	6.36	5.21	105.37	6.06	33.13	5.60	29.32
T_5: 75% RDF + 10 t ha^{-1} FYM + 4.5 t ha^{-1} VC	243.06	32.92	39.02	1.98	60.91	6.57	5.53	117.96	7.79	32.34	5.68	28.40
T_6: T_5 + Biofertilizer	249.93	33.60	40.68	1.90	59.02	6.51	5.35	102.73	6.45	33.37	5.28	31.22
T_7: 75% RDF + 10 t ha^{-1} FYM + 3.75 t ha^{-1} PM	250.53	31.25	39.66	1.98	62.95	6.33	5.37	101.50	6.86	33.89	5.38	28.64
T_8: T_7 + Biofertilizer	251.61	31.79	40.07	1.91	64.95	6.50	5.30	112.72	7.83	34.19	5.58	34.12
T_9: 50% RDF + 10 t ha^{-1} FYM + 6 t ha^{-1} VC	250.33	32.46	45.21	2.06	59.39	6.59	5.36	119.17	7.63	36.34	5.62	31.25
T_{10}: T_9 + Biofertilizer	253.65	30.85	44.63	1.83	58.57	6.53	5.39	116.78	7.62	37.90	5.60	34.62
T_{11}: 50% RDF + 10 t ha^{-1} FYM+ 5 t ha^{-1} PM	258.58	32.15	46.83	1.96	71.65	6.73	5.60	122.39	9.62	38.16	5.73	34.57
T_{12}: T_{11} + Biofertilizer	252.19	36.88	47.49	2.42	74.69	6.85	5.50	134.33	10.77	38.90	5.55	40.02
T_{13}: 100% RDF (200:100:100 NPK kg ha^{-1})	221.30	28.79	38.99	1.20	28.69	5.75	4.71	91.47	3.32	27.37	4.82	24.40
SEM (±)	**3.84**	**0.45**	**0.44**	**0.11**	**5.76**	**0.14**	**0.09**	**3.06**	**0.70**	**1.44**	**0.06**	**1.28**
LSD (0.05)	**10.82**	**1.27**	**1.25**	**0.30**	**16.21**	**0.39**	**0.25**	**8.62**	**1.98**	**4.05**	**0.16**	**3.60**

Table 3: Interaction effect of planting dates and nutrient levels on growth, yield and quality of tomato

Interaction	Plant height (cm)	No. of leaves plant^{-1}	Days to 50% flowering	Leaf area index	Fruits plant^{-1}	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield (kg plant^{-1})	Fruit yield (kg plot^{-1})	TSS (^{0}Brix)	Ascorbic acid content (mg 100^{-1} g)
D1xT1	260.61	27.86	39.77	1.46	84.94	6.33	5.27	111.81	9.34	34.66	5.23	23.48
D1xT2	250.47	29.56	39.13	1.51	51.28	6.53	5.44	110.09	5.53	35.61	5.22	24.48
D1xT3	254.15	32.79	41.42	2.05	78.05	6.74	5.33	131.16	10.86	43.11	5.32	25.06
D1xT4	266.26	33.26	41.70	1.95	69.39	6.77	5.41	117.59	8.22	42.72	5.77	25.42
D1xT5	250.81	35.06	39.70	2.20	73.28	6.92	5.75	137.20	10.32	39.17	5.87	25.78
D1xT6	257.36	38.53	41.17	1.95	65.83	6.71	5.59	109.53	7.16	41.78	5.42	31.81
D1xT7	258.58	36.32	40.27	2.50	86.39	6.49	5.50	114.14	9.75	45.57	5.92	26.70
D1xT8	262.41	32.93	40.57	2.15	80.61	7.10	5.74	128.71	10.36	44.28	5.67	29.78
D1xT9	257.25	35.01	46.60	2.43	85.72	7.11	5.63	131.87	11.42	45.73	5.60	28.81
D1xT10	253.66	30.86	48.98	2.19	91.50	6.92	5.73	138.70	12.94	47.19	5.66	29.31
D1xT11	256.75	34.13	47.47	2.16	111.05	6.95	6.00	138.09	15.43	49.49	6.07	36.81
D1xT12	253.65	39.39	47.84	2.75	132.72	7.14	5.72	156.26	19.99	49.05	5.42	38.43
D1xT13	232.36	29.36	39.70	1.44	34.28	6.05	4.81	90.20	3.70	33.37	5.02	21.81
D2xT1	236.29	28.96	40.28	1.30	89.99	6.63	5.63	109.42	9.75	29.72	4.97	26.29
D2xT2	263.34	29.92	42.42	1.43	86.88	6.36	5.28	91.78	7.95	30.14	5.27	32.37
D2xT3	245.28	30.95	40.08	2.12	50.44	6.44	5.23	106.77	5.33	31.98	5.32	26.87
D2xT4	257.45	34.81	40.62	2.32	58.77	6.13	5.13	103.99	5.92	31.92	5.52	38.62
D2xT5	237.15	33.95	39.32	2.50	71.55	6.49	5.60	117.66	8.46	32.86	5.57	32.42
D2xT6	245.92	33.63	40.92	2.66	62.55	6.41	5.16	101.72	6.19	34.97	5.07	32.37
D2xT7	245.07	30.96	39.82	2.07	47.66	6.38	5.53	102.16	4.75	33.32	5.12	32.43
D2xT8	241.10	33.25	40.18	2.06	71.77	6.49	5.39	107.44	7.74	35.44	5.72	44.87
D2xT9	231.61	33.15	45.65	2.39	50.99	6.42	5.38	119.94	6.08	38.22	5.72	32.37
D2xT10	251.50	32.78	42.25	1.98	50.22	6.29	5.35	102.23	5.18	38.67	5.72	41.33
D2xT11	255.70	33.35	46.65	2.15	72.99	6.67	5.62	118.66	8.76	38.34	5.67	32.40
D2xT12	238.15	36.49	48.05	2.91	53.77	6.74	5.48	127.33	7.16	38.96	5.77	44.87
D2xT13	216.05	30.95	39.98	1.36	25.44	5.69	4.81	95.67	3.06	26.97	4.72	32.42
D3xT1	243.75	24.09	37.45	0.92	32.01	6.23	5.30	105.03	4.22	24.22	4.91	19.67
D3xT2	256.10	27.68	39.22	0.94	32.68	6.05	5.47	97.92	3.79	23.54	5.01	22.16
D3xT3	264.98	26.57	37.65	0.99	32.23	6.11	5.11	91.08	3.66	23.19	5.21	24.50
D3xT4	263.18	27.41	40.35	0.98	33.23	6.19	5.09	94.53	4.02	24.74	5.51	23.94
D3xT5	241.23	29.74	38.05	1.23	37.90	6.30	5.23	99.03	4.58	25.01	5.61	27.00
D3xT6	246.51	28.64	39.95	1.08	48.68	6.42	5.30	96.95	5.99	23.36	5.36	29.50
D3xT7	247.93	26.47	38.88	1.38	54.79	6.13	5.08	88.19	6.07	22.78	5.11	26.81
D3xT8	251.31	29.20	39.45	1.52	42.46	5.89	4.78	102.01	5.38	22.84	5.36	27.72
D3xT9	262.13	29.21	43.38	1.36	41.46	6.24	5.06	105.69	5.40	25.07	5.55	32.56
D3xT10	255.80	28.91	42.65	1.31	34.01	6.38	5.09	109.42	4.74	27.82	5.41	33.23
D3xT11	263.28	28.97	46.38	1.58	30.90	6.58	5.18	110.42	4.67	26.66	5.46	34.50
D3xT12	264.78	34.76	46.58	1.60	37.57	6.66	5.29	119.42	5.15	28.71	5.46	36.77
D3xT13	215.50	26.08	37.28	0.81	26.34	5.51	4.51	88.55	3.20	21.76	4.71	18.97
SEM (±)	**6.66**	**0.78**	**0.77**	**0.18**	**9.97**	**0.24**	**0.16**	**5.31**	**1.22**	**2.49**	**0.10**	**2.21**
LSD (0.05)	**NS**	**2.20**	**2.17**	**NS**	**28.08**	**0.67**	**NS**	**14.94**	**3.43**	**NS**	**0.28**	**6.23**

fertilizers to the soil in conjunction with inorganic fertilizer, which increases the availability of nutrients considerably resulting in positive effect on growth parameters.

Treatment combination of having planting date 15th September + 50% RDF + 10 t haFYM + 5 t ha^{-1} poultry manure + biofertilizer (D1T12) recorded significantly maximum number of leaves (39.39) per plant, while the minimum (24.10) was recorded in treatment interaction D3T1 (15th October + 100% RDF + 10 t ha^{-1} FYM + 3 t ha^{-1} vermicompost).

Effect on yield and attributing characters

The date of planting exhibited marked influence on all the yield and yield components of tomato fruit. In the present study planting date 15th September (D1) exhibited significant higher values for days to 50% flowering (42.64 days), fruits per plant (80.39), fruit length (6.75 cm), fruit girth (5.53 cm), mean fruit weight (124.26 g), yield per plant (10.39 kg) and yield per plot (42.44 kg). Whereas, it was recorded lowest in 15th October (D2) planting date, which indicated a deceased trends noticed towards later dates of planting and yield levels were much higher in earlier then later planting date.

Similar results were also observed by Jamwal *et al.* (1995) recorded highest early and total yields by sowing earlier. Hossain (2001) obtained highest yield of tomato (86.40 t ha^{-1}) at early planting and lowest as planting was delayed.

Fertilizer levels having organic and inorganic sources showed significant influence on phenology and fruit yield of tomato. Earliest 50 % flowering (40.56 days) was observed in planting date D3 (15th October). While the maximum value for fruits per plant (74.69), fruit length (6.85 cm), mean fruit weight (134.33 g),yield per plant (10.77 kg) and yield per plot (38.90 kg) was recorded with T12 (50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure + biofertilizer).Whereas, the lowest value for these parameters was recorded in treatment T13 (100% RDF). Yeptho *et al.* (2012) on application of 50% NPK + 50% poultry manure + biofertilizers recorded maximum fruit yield of tomato. These results indicate positives effects of integrating NPK with manures as well as bio fertilizers. The efficacy of inorganic fertilizer is much pronounced when they are combined with organic manure.

In the present study variation due to interaction of planting date and different sources of nutrients showed significant result in yield and yield attributing characters of tomato. Treatment combination of planting date 15th September when applied with nutrients of 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure + biofertilizer (D1T12) exhibited maximum fruits per plant (132.72), fruit length (7.14 cm), mean fruit weight (156.26g), fruit yield per plant (19.99 kg) at par with D1T11 (15th September + 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure) which recorded maximum fruit girth (5.99cm) and fruit yield /plot (49.49 kg) as compared to other treatment combinations under study. While, the minimum value for these parameters were observed in D3T13 (15th October +100% RDF). The interaction between growing environment and nutrients showed positive effect on growth and yield characters. This finding is also in agreement with the findings of Basavaraja *et al.* (2003) for capsicum and okra indicating the positive and favorable influence of these two characters on yield parameters.

Effect on fruit quality

It is evident from table 1.The highest value of TSS (5.55 ºB) and ascorbic content (34.59 mg/100g) was obtained from the plants planted at 15th September and 30th September, respectively. However, when the planting was delayed the maximum parameters had shown the lowest values. These results are in accordance with findings of Bhardwaj (1993) and Jeevansab (2000).

Application of 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure and 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure + biofertilizer resulted significantly higher TSS (5.73* Brix) and ascorbic acid (40.02 mg/100g) over other treatments. The higher level these content in tomato fruit may be due to action of specific soil nutrients which may be made more readily available into soil for plant absorption as a result of mineral fertilizer + organic manure with or without bio fertilizers, which in turn may activate specific enzymes for the synthesis of these compounds. It is therefore certain that specific nutrients in soil play vital role in determining the quality parameters. The maximum TSS and ascorbic acid with application of 50% NPK + 50% FYM+ bio fertilizers were also observed in findings of Vimera *et al.* (2010) in chilli, Deepika *et al.* (2010) in radish.

The crop sown in 30th September with application of 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure (D1T11) showed highest value for TSS of fruit (6.07).On the other hand maximum ascorbic acid content (44.87 mg100^{-1} g) was obtained in treatment combination D2T8 (30th September + 75 % RDF + 10 t ha^{-1} FYM + 3.75 t ha^{-1} poultry manure +

biofertilizer).While, the minimum value for these traits was noticed in D3T13 (15th October + 100% RDF).

On the basis of present investigation it is concluded that the tomato variety Katrina responded well in terms of growth, yield and quality characters with different date of planting and integrated nutrient management under poly house condition. The result indicated that the crop sown in 15 September with application of 50% RDF + 10 t ha^{-1} FYM + 5 t ha^{-1} poultry manure + biofertilizer showed better performance for all growth, yield and quality parameters and observed as most promising treatment under poly house condition for tomato.

REFERENCES

Anonymous 2013. Indian Horticulture database, Published by Ministry of Agriculture, GOI.

Anonymous 1980. Methods of Analysis of Association of official Analytical Chemists, Washington D.C., U.S.A.

Basavaraja, N., Nandi, V. R. and Jholgikar, P. 2003. Protected cultivation of capsicum and bhendi. Proc. of All India on Sem. Potential and Prospects for Protective Cultivation, organized by the Institute of Engineers, December 12-13, Ahmednagar, pp. 197-99.

Bhardwaj, R.K.1993. Studies on spacing and time of planting in some indeterminate tomato cultivars. *M. Sc. Thesis*, Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan.

Brahma, S., Barua, P., Saikia, L. and Hazarika, T. 2009. Studies on response of tomato to different levels of N and K fertigation inside naturally ventilated polyhouse. *Veg. Sci*., **36**: 336-39.

Deepika, Singh, A.K., Kanaujia, S.P. and Singh, V.B. 2010. Effect of integrated nutrient management on growth, yield and economics of capsicum (*Capsicum annum L.*) cv. California Wonder. *J. Soils and Crops*, **20**:33-38.

Hamma, I.L., Ibrahim, U. and Haruna, M. 2012. Effect of planting date and spacing on the growth and yield of sweet pepper (*Capsicum annuum* L.) in samara area of Zaria in Nigeria. *Nigerian J. Agric. Food and Env*., **8**:63-66

Hossain, M.M., 2001. Influence of planting time on the extension of picking period of four tomato varieties. *M. Sc. Thesis*, Dept. of Hort., BAU, Mymensingh, pp. 46.

Islam, M., Saha, S., Akand, H. and Rahim, A. 2010. Efffect of sowing date on the growth and yield of sweet pepper *(Capsicum annuum* L.) *Agronomski Glasnik*, 1/2010.

Jamwal, R.S., Prakash, S. and Thakur, D.R. 1995. Response on tomato cultivars to planting date and spacing under alluvial sand deposits. *Himachal J. Agric. Res*., **21**: 27-31.

Jeevansab, 2000. Effect of nutrient sources on growth, yield and quality of capsicum grown under different environments. *M. Sc. Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Kadam, D.D. and Deore, B.P. 1990. Influence of planting date on the yield and fruit characters of tomato. *J. Maharashtra Agric. Univ*., **15**: 264-65.

Khan, Zehra., Ali, S. T., Mahmood, Irshad. and Rizvi, Rose. 2012. Effects of N fertilization, organic matter, and biofertilisers on the growth and yield of chilli in relation to management of plant-parasitic nematodes. *Turkey J. Bot*., **36**: 73-81.

Malawadi, M. N. 2003. Effect of secondary and micronutrients on yield and quality of chilli (*Capsicum annuum* L.). *M. Sc. Thesis*, Univ. Agril. Sci., Dharwad.

Vimera, K., Kanaujia, S.P., Singh, V.B. and Singh, P.K. 2010. Effect of integrated nutrient management on growth and yield of King Chilli under foothill condition of Nagaland. Abstract of National Seminar on "Sustainable Natural Resources and its utilization for enhancing the Agricultural productivity in India" held at NU: SASRD, Nagaland, 17-19 Nov. 2010.

Yeptho, V., Kanaujia, S.P., Singh, V.B. and Sharma Amod., 2012. Effect of integrated nutrient management on growth, yield and quality of tomato under polyhouse condition. *J. Soils and Crops*, **22**:246-52.