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HORTICULTURE

Effects of vermicompost and boron on tomato (*Solanum lycopersicum* cv. Pusa ruby) flowering, fruit ripening, yield and soil fertility in acid soils

Haribhushan Athokpam[1], Shabir Hussain Wani[2], Indira Sarangthem[3] and N. Anando Singh[4]

[1]Krishi Vigyan Kendra (Farm Science Centre), Senapati District, P.O. Kangpokpi-795129, Manipur, India

[2] Division of Genetics and Plant Breeding, FoA, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura Sopore, Jammu and Kashmir, India

[3]Department of Soil Science and Agricultural Chemistry, Central Agricultural University, College of Agriculture, Iroisemba, Imphal, 795004, Manipur, India

[4]AICRP on Chickpea, Directorate of Research, Central Agricultural University, Imphal, 795004, Manipur, India

*Corresponding author: athokpamharibhushan@yahoo.com

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Abstract

It was evident from a two year experiment that among the combination between vermicompost and boron, the application of minimum dose of boron (B_1=10Kg/ha) with maximum dose of vermicompost (V_3=20q/ha) i.e. B_1V_3 application reduced the number of days taken to flowering, 50% of flowering, ripening, 50% of ripening as compared to the other treatments and found superior in increasing the available N, P_2O_5, K_2O, and Organic carbon in soil. The highest fruit yield was recorded with the combined application of 10 kg borax and 20 q vermicompost (1% N) / ha. The same treatment i.e. B_1V_3, was also found to be superior in increasing the better results regarding most of the parameters. Moreover the application B_1V_3 increased availability of N,P,K and Organic Carbon, which exerts positive effect on growth, development and yield of tomato.

Highlights

- Vermicompost not only supplies essential elements to plants but also improves physico-chemical and biological properties of soil.
- B deficiency is the most widespread micronutrient deficiency.
- Boron improves growth, yield, quality and nutrient content of tomato. The quality of crops is also influenced due to boron and the timely application of boron helps in increasing the size of fruits as well as firmness.

Keywords: Vermicompost, boron, tomato, acidic soil

Tomato (*Solanum lycopersicum*) is the second most important vegetable crop next to potato (Kumar *et al.*, 2015). It is grown practically on all kinds of soil from light sandy to heavy clay. But a well drained rich loamy soil is ideal for its cultivation. Comparing with other states of India, the production of tomato in Manipur is very less and almost negligible as suitable high yielding varieties are not available. On the other hand, in day today life, the demand for such nutritive vegetables is increasing. It becomes quite necessary to increase the productivity of tomato in order to meet the increasing demand of the state. It is exceptionally rich in vitamins A,B,C,D, along with a rich source mineral salt of sulphur potassium, iron and calcium. The vitamins contained in tomato are not easily destroyed in ordinary cooking. The pulp and juice of the fruit are digestible and a mild aperients. It is a promoter of gastric antiseptic and has culinary effect in the entire portion of alimentary canal. It removes constipation and strengthens the teeth. Tomato crop requires heavy manure and sufficient amount of fertilizers for heavy yield. For improving plant growth and development, use of organic and inorganic manure or fertilizers is essential (Prakash *et al.,* 2002). Average fruit and seed yield per unit area under tomato in India is comparatively low as compared to other countries which can be enhanced by judicious use of macro and micronutrients.

Vermicompost are products derived from the accelerated biological degradation of organic wastes by interactions between earthworms and microorganisms. Earthworms consume and fragment the organic wastes into finer particles by passing them through a grinding gizzard, and they derive their nourishment from the microorganisms that grow on the organic matter. (Ibrahim *et al.*, 2016). Vermicompost contains more number of N_2 fixing, phosphate solubilizing and other beneficial microbes, antibiotics, vitamins, hormones, enzymes, etc. which have better effect on growth and yield of plants (Bhawalkar 1992).

An organic manure (Vermicompost) produced due to conversion garbage by earthworms is richer in essential plant nutrients than ordinary farm yard manure. It not only supplies essential elements to plants but also improves physico-chemical and biological properties of soil (Purakayastha *et al.*, 1997). Using organic source of nutrients increased the nutrient status of the soil, potentiality of vermicompost and FYM increases the N, P_2O_5, K_2O and micro nutrient content (Reddy and Reddy 1998). Vermicompost are effective organic fertilizers and biocontrol agents (Edwards and Arancon 2004, Ersahin Y.S. 2011). Vermicomposts can improve food quality without compromising with food safety (Ersahin Y.S. 2011). Applications of vermicompost singly or in combination with either other organic fertilizers or chemical fertilizers have been proved effective to enhance growth and yield of various crop plants like Urad and Soybean (Javed and Panwar 2013,) and fruits like lemon (Singh *et al.*, 2015).

Boron (B) deficiency is the most widespread micronutrient deficiency. Many fruit vegetable and field crops suffer from B deficiency. Boron deficiency prevents root growth and disrupts cell membranes, which has a direct effect on plant's uptake mechanism. On the other hand, excess boron can block the transportation of calcium, so it is important that accurate application rates are adhered to. Boron accumulates in the leaf margins, turning them black. Root death occurs where levels are particularly high. Soils with high levels of boron can be ameliorated by leaching though micronutrients are required in small quantities yet they play a significant role in modifying various physiological functions of the plant. B plays an essential role in the development and growth of new cells in the plant meristem. Flowering and fruit development are also restricted by a shortage of B. Like other nutrients, boron has a pronounced effect on the production and quality of tomato. Boron is needed by the crop plants for cell division, nucleic acid synthesis, uptake of calcium and transport of carbohydrates (Bose and Tripathi 1996). Boron improves growth, yield, quality and nutrient content of tomato, (Davis *et al.,* 2003). The quality of crops is also influenced due to boron and the timely application of boron helps in increasing the size of fruits as well as firmness. Tomato crop is responsive to foliar application of nutrients especially during critical stages.

Materials and Methods

A field experiment was conducted during 'Rabi' season of 2003-2004 and 2004-2005 at the research farm of College of Agriculture, Central Agricultural University, Imphal to evaluate the effect of vermicompost at four levels (V_0=0q/ha, V_1=10q/ha, V_2=15q/ha and V_3=20q/ha) and boron fertilization in the form of borax (B_0=0 Kg/ha, B_1=10Kg/ha, B_2=15Kg/ha and B_3=20 Kg/ha) on tomato flowering, ripening, yield and fertility of soil under acidic soil condition of Manipur.

The soil was clay texture before growing the crop with 8.5% sand, 24.7% silt, 66.8% clay, pH 5.2, EC 0.20 dS/m, organic carbon 2.83%, CEC 24.00 C mol (P+) kg^{-1} the available N,P,K and B were 407.68, 25.65, 314.50 Kg/ha and 0.0037ppm respectively. Vermicompost contained 1.11% N, 0.57% P_2O_5, 0.78% K_2O and 0.0095 ppm of B. Experiment was laid out in factorial randomized block with three replications. The treatments included 4 levels each of vermicompost i.e. V_0= 0 q/ha, V_1=10 q/ha, V_2= 15q/ha and V_3=20 q/ha and 4 levels of boron i.e. B_0=0 Kg/ha, B_1=10 Kg/ha, B_2= 15 Kg/ha, B_3=20 Kg/ha. The vermicompost was applied 15 days ahead of transplanting and boron was applied as soil application in the form of borax at 25 days after transplanting. The soil samples collected from each of the plots after tomato plant were analysed for organic carbon (Walkley and Black 1934), available N (Khanna and Yadav 1979), available P (Bray and Kurtz 1945, Jackson 1973) and available K (Flame Photometer method, Jackson, 1973).

Results and Discussion

Days to first flowering and 50% flowering

The number of days to first flowering and 50% flowering was significantly influenced by the interaction between vermicompost and boron over the control and other treatments (Table 1 & 2).

Applications of B_1V_3 was found to possess the lowest number of days to first flowering (52.83 DAT) as well as 50% flowering (57.00 DAT) whereas the highest of days to first flowering (82.00 DAT) and 50% flowering (84.33 DAT) was recorded with B_3V_1 application.

The delayed in flowering by the application of B_3V_1 may be due to the higher dose of boron. This is in agreement with findings of Goldberg *et al.* 2003 who found that the number of days to first flowering was significantly delayed at the two highest B treatments in melons.

Days to first ripening and 50% ripening

The number of days to first ripening and 50% ripening was significantly influenced by the applications of vermicompost (Table 3 & 4). The lowest number of days to first ripening (107.83) and 50% ripening (112.50) was recorded by the application of B_0V_3, which was followed by B_0V_2 and B_0V_1 respectively. Similar results were also reported by Rafi *et al.* 2001.

Application of boron gave a significant effect on the number of days to first and 50% ripening. The lowest number of days to (108.67) and 50% ripening (114.17) was obtained by B_1V_0 application. The number of days to first and 50% ripening was increased with the increasing levels of boron. Similar opinion was also reported by Jhonstone and Fisher (1930), Emmert (1961), Adams and Winsar (1974) and Davis *et al.* (2003). Among the combination between vermicompost and boron application of 20 q/ha vermicompost and 10 Kg/ha boron i.e. B_1V_3

Table 1: Influence of vermicompost and boron on days to first flowering

Year		**2003-2004**					**2004-2005**					**Pooled**				
B	**V**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**
B_0		78.67	73.33	72.00	68.33	73.08	71.33	64.67	63.00	58.33	64.33	75.00	69.00	67.50	63.33	68.71
B_1		68.00	62.00	60.67	55.33	61.55	63.33	56.00	52.33	50.33	55.50	65.67	59.00	56.50	52.83	58.50
B_2		73.67	71.33	68.67	60.33	68.50	71.00	69.67	65.67	52.67	64.75	72.33	70.50	67.17	56.50	66.62
B_3		81.33	79.00	76.67	71.67	77.17	82.67	79.33	76.33	67.33	76.42	82.00	79.17	76.50		
Mean		76.42	71.42	69.50	63.92	70.75	72.08	67.42	64.33	57.17	65.25	73.75	69.42	66.92	60.55	
C.D 5%			1.06	1.06	2.14			1.16	1.16	2.31			0.76	0.76	1.54	

Table 2: Influenced of vermicompost and boron on number of days to 50% flowering

Year		**2003-2004**					**2004-2005**					**Pooled**				
B	**V**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**
B_0		84.33	79.33	77.00	73.33	78.50	77.33	70.00	71.00	62.33	70.17	80.83	74.67	74.00	67.83	74.33
B_1		73.00	66.6	65.00	60.00	66.17	69.00	60.67	56.00	54.00	59.92	71.00	63.67	60.50	57.00	63.04
B_2		78.33	76.33	74.33	64.00	73.25	77.00	75.33	72.33	57.33	70.50	77.67	75.83	73.33	60.67	71.87
B_3		86.67	82.33	80.67	75.67	81.34	89.67	86.33	81.67	73.67	82.84	88.17	84.33	81.17	74.64	82.08
Mean		**80.58**	**76.17**	**74.25**	**68.25**	**74.81**	**78.25**	**73.08**	**70.25**	**61.83**	**70.85**	**79.42**	**74.62**	72.25	65.03	72.83
C.D 5%			1.20	1.20	2.41			1.80	1.80	3.59			1.04	1.04	2.10	

Table 3: Influenced of vermicompost and boron on number of days to first ripening

Year	2003-2004					2004-2005					Pooled				
B V	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean
B_0	124.33	118.67	117.33	113.67	118.50	116.33	108.00	107.33	102.00	108.42	120.33	113.33	112.33	107.83	113.46
B_1	112.67	106.33	105.33	99.00	105.83	104.67	99.00	95.67	93.00	98.09	108.67	102.67	100.50	96.00	101.96
B_2	118.67	116.67	113.67	104.00	113.25	115.33	115.33	110.67	99.00	110.08	117.00	116.00	112.17	101.50	11.67
B_3	126.67	123.67	121.00	115.67	121.75	126.33	125.33	121.67	110.00	120.83	126.50	124.50	121.33	112.83	121.29
Mean	120.59	116.34	114.33	108.09	114.83	115.67	111.92	108.84	101.00	109.36	118.13	114.13		111.59	
C.D 5%		1.35	1.35	2.70			1.18	1.18	2.37			0.88	0.88	1.74	

Table 4: Influenced of vermicompost and boron on number of days to 50% ripening

Year	2003-2004					2004-2005					Pooled				
B V	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean
B_0	129.00	123.33	122.67	117.67	123.17	121.67	113.00	115.00	107.33	114.25	125.33	118.17	118.83	112.50	118.71
B_1	117.00	111.33	109.67	104.00	110.50	111.33	103.00	100.67	97.67	103.17	114.17	107.17	105.17	100.83	106.83
B_2	122.33	122.00	119.33	108.33	118.00	121.33	122.33	115.33	103.00	115.50	121.83	122.17	117.33	105.67	116.75
B_3	132.33	127.33	125.33	120.67	126.33	134.00	132.33	128.33	116.33	127.75	133.17	129.83	126.83	118.50	127.04
Mean	125.17	121.00	119.25	112.67	119.52	122.08	117.67	114.83	106.08	115.17	123.62	119.34	117.04	109.38	117.34
C.D 5%	1.59	1.59	3.17	1.80	1.80	3.61	1.16	1.16	2.34						

Table 5: Influenced of vermicompost and boron on yield (q ha^{-1})

Year	2003-2004					2004-2005					Pooled				
B V	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean
B_0	150.09	206.43	248.82	288.05	**223.35**	172.54	229.09	261.07	316.98	**244.91**	161.32	217.76	254.95	302.51	234.13
B_1	215.77	283.20	295.11	332.11	**281.55**	232.86	309.07	362.30	388.96	**323.30**	224.31	296.13	328.70	360.54	302.42
B_2	197.38	260.92	285.77	292.44	**259.13**	210.16	280.36	312.79	342.54	**286.46**	203.77	270.64	299.28	317.49	272.79
B_3	165.88	174.20	192.84	199.24	**183.04**	189.60	196.30	204.40	213.40	**201.05**	177.74	185.25	198.87	206.32	192.04
Mean	**182.28**	**231.19**	**255.63**	**277.96**	**236.96**	**201.29**	**253.26**	**285.26**	**315.47**	**263.93**	**191.78**	**242.44**	**270.45**	**296.45**	250.34

	V	B	VXB	V	B	VXB	V	B	VXB
S.E. (d)+_	1.81	1.81	3.62	1.70	1.70	3.41	1.24	1.24	2.49
C.D 5%	3.69	3.69	7.39	3.47	3.47	6.96	2.48	2.48	4.96

significantly decreased with the number of days to first (96.00) and 50% ripening (100.83).

Influence of vermicompost and boron on yield (q ha^{-1})

Data on yield in both the years of experimentation as influenced by different treatments and their pooled analysis data are presented in Table 5. Different doses of vermicompost significantly influenced the yield in both the years of experimentation and in the pooled mean data analysis. In the first year experiment (2003-2004), the highest yield (260.05 q ha^{-1}) was observed with B_0V_3 application followed by B_0V_2 and B_0V_1, respectively. In the second year experiment (2004- 2005), the highest yield (423.98 q ha^{-1}) was recorded with the application of B_0V_3. The data revealed that the yield of tomato was higher during the second year (2004-2005) as compared to that of first year (2003-2004). The application of boron had a significant effect on the yield of tomato in both the years of experimentation. In the first year experiment (2003-2004), the highest yield (172.44 q ha^{-1}) was observed with the application of B_1V_0. In the second year experiment (2004-2005), the highest yield (260.19 q ha^{-1}) was observed with the application B_1V_0 followed by B_2V_0 and B_3V_0, respectively. The data revealed that the yield of tomato was higher during the second year (2004-2005) as compared to that of first year (2003-2004). The similar trend of findings was observed in the pooled mean data analysis.

Table 6: Influenced of Vermicompost and boron on soil organic carbon (OC)(%)

Year	2003-2004					2004-2005					Pooled				
B V	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**
B_0	2.83	2.84	2.84	2.85	2.84	2.80	2.84	2.85	2.86	2.84	2.81	2.84	2.84	2.86	2.84
B_1	2.80	2.84	2.85	2.87	2.84	2.79	2.85	2.86	2.88	2.84	2.79	2.84	2.85	2.87	2.84
B_2	2.79	2.81	2.82	2.84	2.81	2.79	2.82	2.84	2.84	2.82	2.79	2.81	2.83	2.84	2.82
B_3	2.77	2.78	2.79	2.81	2.79	2.79	2.78	2.81	2.83	2.80	2.79	2.78	2.80	2.82	2.80
Mean	**2.80**	**2.82**	**2.82**	**2.84**	**2.82**	**2.79**	**2.82**	**2.84**	**2.85**	**2.82**	**2.79**	**2.82**	**2.83**	**2.85**	**2.82**
C.D 5%		0.010	0.010	0.018			0.012	0.012	0.022			0.008	0.008	0.014	

Table 7: Influenced of vermicmpost and boron on soil available nitrogen (Nkg/ha)

Year	2003-2004					2004-2005					Pooled				
B V	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**	**V_0**	**V_1**	**V_2**	**V_3**	**Mean**
B_0	441.13	459.95	493.40	526.85	480.33	447.40	472.49	503.85	531.03	488.69	444.26	466.22	498.62	528.94	484.51
B_1	468.31	466.22	499.67	531.03	491.31	485.03	491.31	518.48	543.57	509.60	476.67	478.76	509.08	537.30	500.45
B_2	447.40	453.67	485.03	516.39	475.62	453.67	478.76	497.58	524.76	488.69	450.54	466.22	491.31	520.58	482.16
B_3	428.59	447.40	478.76	503.85	464.65	424.41	441.13	472.49	497.58	458.90	426.50	444.26	475.62	500.71	461.77
Mean	446.36	456.81	489.21	519.53	477.98	452.63	470.92	498.10	524.23	486.47	449.49	463.86	493.66	521.88	**482.22**

	V	B	VXB	V	B	VXB	V	B	VXB
S.E. (d)+_	1.27	1.27	2.53	0.83	0.83	1.66	0.75	0.75	0.51
C.D 5%	2.59	2.59	5.17	1.69	1.69	3.39	1.50	1.50	3.02

Soil properties as influenced by vermicompost and boron

Organic Carbon

The result (Table 6) revealed that there was a significant increase in the organic carbon content due to the application of vermicompost. The highest redidual organic carbon content in soil (2.86%) was recorded by the application of 20q/ha of vermicompost i.e. B_0V_3 which was followed by 15q/ha of vermicompost (2.84%) i.e. B_0V_2 and 10q/ha of vermicompost (2.84%) i.e. B_0V_1 application, respectively. Similar opinion was also reported by Nethra *et al.* (1990), and Shrikanth *et al.* (2000). Application of boron had no significant effect on the organic carbon content in soil. Among the combination between vermicompost and boron, the best combination was obtained (2.87%) by the application of 20kg/ha of boron with 10q/ha of vermicompost i.e. B_3V_1. Application of vermicompost with inorganic fertilizer increased the organic carbon content in the soil (Vasanthi and Kumaraswamy, 1999).

Available nitrogen in soil (N kg/ha)

The result (Table 7) indicated that application of vermicompost significantly increased the available nitrogen. Application of maximum level of vermicompost i.e. 20q/ha of vermicompost (B_0V_3) received (528.94kg/ha) the highest available nitrogen. Significant increased in available nitrogen due to incorporation of vermicompost and boron; the application of 10kg/ha of boron and 20q/ha of vermicompost i.e. B_1V_3 recorded (537.30kg/ha) the highest content of available nitrogen in soil whereas the application 20kg/ha of boron with 10 q/ha of vermicompost i.e. B_3V_1 recorded (444.26kg/ha) the lowest residual available nitrogen in soil.

Available phosphorus in soil (P_2O_5 kg/ha)

The result (Table 8) revealed that application of vermicompost significantly increased the available phosphorus of soil. Application of vermicompost @20q/ha recorded (42.75kg/ha) the highest available phosphorus. Similar opinion was expressed by Reddy and Reddy (1998). Results on available phosphorus revealed that there was reduction in available phosphorus content of soil with the increasing level of boron. The interaction between vermicopost and boron had a significant effect on the residual available phosphorus of soil. The highest available phosphorus content of soil was

Table 8: Influenced of vermicompost and boron on soil available phosphorous (P_2O_5) kg/ha

Year		2003-2004					2004-2005					Pooled				
B	V	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean
B_0		29.07	30.7	33.34	40.18	33.34	27.36	32.49	38.47	45.31	35.91	28.21	31.63	35.90	42.75	34.62
B_1		29.07	30.78	34.20	44.46	34.63	27.36	31.63	37.62	45.31	35.48	28.21	31.21	35.91	44.88	35.05
B_2		25.65	30.78	34.20	40.18	32.70	25.65	27.36	32.49	36.76	30.58	25.65	29.07	33.34	38.47	31.63
B_3		25.65	27.36	30.78	33.34	29.28	25.65	25.65	32.49	34.20	29.50	25.65	26.50	31.63	33.77	29.39
Mean		**27.36**	**29.92**	**33.13**	**39.54**	**32.49**	**26.50**	29.28	35.27	40.39	32.86	26.93	29.60	34.19	39.97	32.67

	V	B	VXB	V	B	VXB	V	B	VXB
S.E.(d) +_	0.72	0.72	1.44	0.69	0.69	1.38	0.50	0.50	1.00
C.D.5%	1.47	1.47	2.94	1.41	1.41	2.82	1.00	1.00	2.00

Table 9: Influenced of vermicompost and boron on available potassium in soil (kg/ha)

Year		2003-2004					2004-2005					Pooled				
B	V	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean	V_0	V_1	V_2	V_3	Mean
B_0		316.62	322.56	327.94	345.85	328.24	320.77	326.15	337.79	350.34	333.76	318.53	324.35	332.87	348.09	330.96
B_1		314.50	340.48	351.23	362.88	342.27	321.66	344.06	361.09	371.84	349.66	318.08	342.27	356.16	367.36	345.97
B_2		310.91	324.35	327.94	337.79	325.25	307.33	320.77	324.35	336.90	322.34	309.12	322.56	326.15	337.34	323.79
B_3		305.53	308.22	312.71	318.08	311.13	303.74	306.43	308.22	320.77	309.79	304.64	307.33	310.46	319.42	310.46
Mean		**311.89**	**323.90**	**329.95**	**341.15**	**326.72**	**313.37**	**324.35**	**332.86**	**344.96**	**328.89**	**312.59**	**324.13**	**331.41**	**343.05**	**327.79**

	V	B	VXB	V	B	VXB	V	B	VXB
S.E.(d)+_	0.94	0.94	1.88	0.89	0.89	1.77	0.65	0.65	1.29
C.D 5%	1.92	1.92	3.84	1.82	1.82	3.61	1.30	1.30	2.58

recorded (44.88kg/ha) by the application of 10kg/ha of boron with 20kg/ha of vermicompost i.e. B_1V_3.

Available potassium in soil (K_2O kg/ha)

The result (Table 9) revealed that application of boron had a significant effect in the available potassium content. The highest available potassium content in the soil was observed (318.08kg/ha) in the plot boron were applied as minimum dose (10 kg/ha) i.e. B_1V_0. Similar opinion was also reported by Prabha and Singaram (1996). Application of vermicompost with or without boron significantly increased the available potassium content as compared to control i.e. B_0V_0. The highest available potassium content of soil was observed (367.36kg/ha) in the plot receiving B_1V_3 treatment i.e. 10kg/ha of boron with 20q/ha of vermicompost.

Conclusion

It is clearly established from the above given discussion that vermicompost and boron is an essential nutrients and plays a pivotal role in the earliness, nutrient content, reduced fruit cracking, yield, and better fertility of soil. Among the vermicompost application, maximum level of vermicompost (20q/ha) was found to be the best in increasing the yield and fertility of soil. Among the different level of boron, the minimum level of boron (10kg/ha) was found to possess the best in decreasing the number of days to flowering and ripening of tomato for the acidic clay soil of Manipur. On the basis of results recorded from this experiment, the following recommendations can be generalized; among various combinations used, B_1V_3 showed better results regarding most of the parameters. Moreover the application B_1V_3 increases availability of N,P,K and Organic Carbon, which exerts positive effect on growth, development and yield of tomato.

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