Effect of micronutrients on yield and economics of gynoecious cucumber (*Cucumis sativus* L) var Kian under naturally-ventilated polyhouse

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 Received: 20.1.2017/Accepted: 31.3.2017

ABSTRACT

The economic analysis was conducted for cultivation of gynoecious cucumber var Kian under naturally-ventilated polyhouse during Kharif season of 2014-2015. The experiment consisting of twenty seven treatments was laid out in factorial randomized block design with three replications. The common cost of cultivation for growing cucumber under naturally-ventilated polyhouse was Rs 131.5/m^2. The maximum yield per plant (5.62 kg), net income of Rs 498.17/m^2 with highest B-C ratio of 3.71 was obtained with foliar application of treatment $B_2Zn_2Fe_2$(boron at 40 ppm + zinc at 40 ppm + iron at 80 ppm) and it was found significantly superior over control.

Keywords: Micronutrients; cucumber; economics; yield; income

INTRODUCTION

Cucumber (*Cucumis sativus* L) is one of the important vegetables grown in open field as well as in polyhouse conditions in India. It is cultivated in both Kharif and summer seasons in northern part of the country. The crop is grown for its tender fruits for fresh consumption as salad or as pickling cucumber for preservation, marinated with vinegar, salt, dill or other spices. Fruits varying in shape, size and colour contain 0.4 per cent protein, 2.5 per cent carbohydrates, 1.5 mg iron and 2 mg vitamin C in 100 g of fresh portion. It is rich in A, B and C vitamins and contents of iron, calcium, phosphors and zinc elements. Fruits are considered good for people suffering from constipation, jaundice and indigestion. In India cucumber occupies 41820 hectares area producing 868020 MT fruit (Anon 2013).

In recent years increasing productivity coupled with quality is becoming very essential to get more returns from per unit area. The protected cultivation being the most efficient means to overcome climate diversity has the potential of fulfilling the requirements of small growers as it can increase the yield manifold and at the same time improve the quality of the produce significantly as per the demand of the market. In the recent past the introduction of gynoecius varieties of cucumber has revolutionized their cultivation under favourable effect on retention of flowers and fruits which increases number and weight of fruits.

Boron is known to be essential for cell wall structure and function likely through its role as a stabilizer of the cell wall pectic network and subsequent regulation of cell wall pore size. A role for B in plant cell walls however is inadequate to explain all of the effects of B deficiency seen in plants (Brown et al 2008). Zinc is essential for the functioning of many enzymes as well as the synthesis for tryptophan, a precursor of indole acetic acid (IAA). In this respect reduction in IAA synthesis in Zn-deficient might result from inhibited synthesis or enhanced degradation of IAA (Cakmak et al 1989). Iron is an essential micronutrient for almost all living organisms because it plays critical role in metabolic processes such as DNA synthesis, respiration and photosynthesis. Further many metabolic pathways are activated by iron and it is a prosthetic group constituent of many enzymes (Rout and Sahoo 2015).

In cucumber cultivation work highlighting the role of micronutrients especially boron, zinc and iron is

very scarce. They play very crucial role in general growth and yield attributes of the crop. However in cucumber the work on micronutrients remained neglected. The objective of the present experiment was to study the individual as well as combination effect of boron, zinc and iron on growth and yield of gynoecious cucumber cv Kian under polyhouse.

MATERIAL and METHODS

The experiment was conducted in factorial randomized block design with three replications under naturally-ventilated polyhouse condition during 2014-15 at College of Horticulture and Forestry, Jhalarapatan, Jhalawar, Rajasthan.

Crop was grown under the polyhouse on black cotton soil having characteristic to shrink during dry condition. There were 27 treatment combinations including three levels of boron (0, 20 and 40 ppm) as source of boric acid, three levels of zinc (0, 20 and 40 ppm) as source of zinc sulphate and three levels of iron (0, 40 and 80 ppm) as source of ferrous sulphate. The crop was grown on raised beds at 60 x 30 cm spacing on drip system. Each treatment consisted of 10 plants for which 10 seeds were sown in two rows of 1.5 meter length. The number of fruits per plant was recorded at each harvest and total was calculated at last harvesting by summation of values of all pickings; yield per plant (kg) was calculated by total yield of fruits at each harvest and yield per plant was computed by marking the summation of yield values at each harvest till the last harvest and the yield per square meter was calculated by multiplying the value of yield per plant (kg) by total number of plants per square meter. Benefit-cost ratio was worked out by using formula of gross monetary returns (m^2)/cost of cultivation (m^2).

Table 1. Interaction effect of boron, zinc and iron on yield and economics of cucumber for per m^2 net area

Treatment B:Zn:Fe (ppm)	Number of fruits/plant	Yield /plant (kg)	Yield/m^2 (kg)	Cost of treatment (Rs)	Total cost (Rs)	Gross returns (Rs)	Net returns (Rs)	Benefit-cost ratio (BCR)
Control (water)	20.80	2.22	12.01	0.00	131.5	240.29	108.79	0.83
0:0:40	25.06	2.71	14.89	0.54	131.5	297.70	165.66	1.25
0:0:80	26.67	2.89	15.94	1.08	131.5	318.75	186.17	1.40
0:20:0	24.20	2.62	14.33	0.35	131.5	286.51	154.66	1.17
0:20:40	28.00	3.10	17.17	0.89	131.5	343.39	211.00	1.59
0:20:80	29.00	3.24	17.93	1.43	131.5	358.57	225.64	1.70
0:40:0	25.13	2.72	15.00	0.71	131.5	299.97	167.76	1.27
0:40:40	30.13	3.37	18.75	1.25	131.5	374.96	242.21	1.82
0:40:80	31.47	3.55	19.81	1.79	131.5	396.14	262.85	1.97
20:0:0	23.60	2.53	13.83	0.51	131.5	276.52	144.52	1.09
20:0:40	27.60	3.02	16.70	1.05	131.5	333.93	201.39	1.52
20:0:80	28.73	3.16	17.52	1.59	131.5	350.32	217.23	1.63
20:20:0	27.80	3.02	16.70	0.86	131.5	333.93	201.57	1.52
20:20:40	32.40	3.84	21.51	1.40	131.5	430.10	297.20	2.24
20:20:80	33.93	4.11	23.08	1.94	131.5	461.67	328.23	2.46
20:40:0	29.13	3.19	17.70	1.21	131.5	353.91	221.20	1.67
20:40:40	34.00	4.12	23.14	1.75	131.5	462.87	329.62	2.47
20:40:80	36.00	4.42	24.90	2.29	131.5	498.03	364.24	2.72
40:0:0	25.00	2.69	14.77	1.01	131.5	295.30	162.79	1.23
40:0:40	29.20	3.22	17.87	1.55	131.5	357.38	224.32	1.69
40:0:80	30.27	3.38	18.81	2.09	131.5	376.16	242.56	1.82
40:20:0	29.13	3.19	17.64	1.37	131.5	352.71	219.85	1.65
40:20:40	33.46	4.15	23.32	1.91	131.5	466.47	333.06	2.50
40:20:80	35.93	4.53	25.55	2.45	131.5	510.96	377.01	2.81
40:40:0	30.40	3.33	18.51	1.72	131.5	370.30	237.08	1.78
40:40:40	40.03	5.17	29.30	2.26	131.5	585.95	452.19	3.38
40:40:80	43.13	5.62	31.65	2.80	131.5	632.97	498.67	3.71
SEm+	0.44	0.044						
$CD_{0.05}$	1.26	0.125						

Sale price= Rs 20/kg

Table 2. Common cost of cultivation of the experimental crop in per m^2 area

Parameter	Units	Rate/unit (Rs/m^2)	Cost/m^2 (Rs)
Cost of polyhouse structure (A)	1000	950	950000
Maintenance of polyhouse (assuming life of structure to be 25 years and repairing of polyfilm at an interval of 5 years)	5 times	180000	900000
Interest on expenditure of polyhouse	(%)	0.09	85500
Sub-total cost of polyhouse (assuming life of structure to be 25 years and repairing of polyfilm at an interval of 5 years)			1935500
Sub-total cost of polyhouse for 1 year		25	77420
Sub-total cost of polyhouse for 4 months			25807
Sub-total cost (A) of polyhouse expenditure on structure per sqm for 4 months			26
Cultivation cost (B)			
Bed preparation			
Ploughing	2 h	400	800
Bed preparation including mixing of vermicompost and fertilizers	3 man days	189	567
Sterilization			
Sterlization of bed with formaldehyde @ 40 ml/m^2	20 l	40	800
Mulching sheet for sterilization	400 m	5	2000
Sub-total cost (B)			4167
Manures and fertilizers (calculated as per net bed area under 1000 sqm polyhouse ie 500 sqm (C)			
Vermicompost @ 2 kg/sqm	1000 kg	5	5000
DAP @ 50 g/sqm	25 kg	25	625
MOP @ 20 g/sqm	10 kg	16	160
Liquid fertilizer (twice a week thus 30 times/crop)			
19:19:19 @ 1.5 kg (10 times)	15 kg	85	1275
$CaNO_3$ @1.0 kg (10 times)	10 kg	80	800
0:0:50 @ 1.0 kg (10 times)	10 kg	75	750
Sub-total cost (C)			8610
Cost of seed (D)			
Seed	2800	5	14000
Cost of raising of seedlings and seed treatment	2800	0.2	560
Sub-total cost (D)			14560
Insecticides and fungicides (E)			
Insecticides for leaf minor, caterpillars and sucking pests	8 times	200	1600
Fungicides for diseases	8 times	200	1600
Labour for spraying	4 man days	189	756
Sub-total cost (E)			3956
Other expenditure (F)			
Electricity charges	4 months	500	200
Harvesting (20-25 pickings)	20 man days	189	3780
Overall supervision for irrigation, fertigation etc	60 man days	189	11340
Total Expenditure			48413
Interest on cultivable cost	48413	0.09	4371
Sub-total cost			52784
Sub-total cost of cultivation (B + C + D + E + F) expenditure on growing of crop/sqm net area	52784	500	105.5
Total cost of growing cucumber in polyhouse/sqm area (A + B + C + D + E + F)			131.5

The component of protected cultivation is being strengthened under national horticulture mission by government of India by imparting 50 per cent subsidy to the farmers. Incentives in terms of subsidy to the tune of 65 and 75 per cent are given by the government of Rajasthan to encourage the farmers for adopting protected cultivation by adding its share of 15 and 25 per cent in central government subsidy depending upon socio-economic status of the farmer. Therefore an attempt has also been made to work out comparative trend of economic returns for cucumber cultivation under naturally-ventilated polyhouse in each case (without subsidy, with 65 and 75% subsidy) for the respective year.

RESULTS and DISCUSSION

The yield attributes were significantly increased with treatment B:Zn:Fe (40:40:80) as it significantly produced the maximum number of fruits per plant (43.13) as compared to control (20.80), maximum yield per plant (5.62 kg) as compared to 2.22 kg in control (Table 1). Essential micronutrients like boron, zinc and iron play an important role in physiology of crop and these are part of enzyme system or catalysts in enzymatic reactions. They act as stimulants in chlorophyll formation, photosynthesis, energy system and catalysts in many metabolic processes of the plants. Some of them act as enzyme formers in these activities (Kumari 2012). Similar results have been recorded by Ciuciuc et al (1998) in watermelon, Singh (2003) and Tamilselvi et al (2002) in tomato and Singh and Randhawa (1970) in muskmelon.

The economics of treatments indicating gross return (Rs/sqm), total cost of cultivation (Rs/sqm), net return (Rs/sqm) and benefit-cost ratio have been worked out from the yield per plant taking into account the prevailing market price of cucumber at the time of harvesting. The cost of cultivation, market rates of produce and other details of cost incurred in treatment application of cucumber are given in Table 2. The data given in Table 1 indicate that the highest gross return (Rs 632.97/m^2), net return (Rs 498.17/m^2) and benefit-cost ratio (3.71) were there with combined application of B:Zn:Fe (40:40:80). The lowest gross return (Rs 240.29/m^2), net return (Rs 108.29/m^2) and benefit-cost ratio (0.83) were recorded under control. Mahmood et al (1995) reported that application of 5 ppm $ZnSO_4$ increased the yield and net benefit (Rs 51659.67/ha) as compared to control (Rs 42687.50/ha) in case of potato. Similar results were recorded by Bhonde et al (1995) in onion and Singh and Singh (2004) in cauliflower.

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