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Development and Evaluation of Bamboo Trellis System for Growing Cucurbits

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ABSTRACT: *In konkan region mostly various cucurbits are grown especially during monsoon season using ground trellis and traditional bower system. No standard trellis system is available suiting to different habits of cucurbits. Failure of trellis occurred, resulting in considerable cost of fruit loss and trellis repair. Three types of trellis system Bower trellis system, T-trellis system and Vertical trellis system were designed and developed using bamboo as structural member. Ridge gourd and bottle gourd were cultivated on different trellis. Total fruit load on Bower trellis system, T-trellis system Vertical trellis system and control system was 6.4 N/m^2, 6.3 N/m^2, 6.2 N/m^2 and 6.3 N/m^2 respectively.*

Key words: Bamboo trellis, cucurbits cultivation.

INTRODUCTION

The low productivity of vegetables which is recorded in konkan is due to some problems in open field cultivation of vegetables like high annual precipitation, torrential rains, high humidity, lack of irrigation facilities, poor farm credit facilities etc. Humid climate is main hurdle in vegetable production in Konkan as it is congenial for incidence of pests and diseases. Trellises can be made from a wide variety of materials. They generally consist of two vertical supports with a mesh suspended between them to provide support for climbing plants. Metal or wooden stakes should be pounded into the ground deeply enough that the trellis doesn't tip over in a strong wind. A six-foot stake pounded a foot into the ground will leave five feet of trellis area. There are many materials that can be used as trellis netting or mesh. Newer products made of plastic are widely available, as are traditional materials such as chicken wire and galvanized fencing. Choose a heavier mesh for larger-fruited and more vigorous crops. Attach the trellis to the supports with nails, staples, plastic locking ties, or lengths of wire. In konkan region various cucurbits are known especially during monsoon season. Mostly they are growth on ground trellis and using traditional bower system constructed in local material like bamboo. No standard trellis system suiting to different growing habits of cucurbits growth in the konkan region. Failure of trellises has occurred resulting in considerable costs from fruit loss and trellis repair. Conversely, some successful trellises appear far stronger, and therefore more costly than necessary. Therefore data was needed to provide objective design trellis structure. Trellis configurations are chosen to conform with local practice or the subjective preference of the trellis contractor. There are no objective design guidelines for vineyards.

MATERIALS AND METHODS

Construction Material

For trellis system following construction material was used.

1. Bamboo
2. Mild steel strips
3. GI wire
4. Nylon rope
5. Tent pegs
6. Nut-bolts
7. Cement concrete
8. PVC pipes

Instrument Used

Weighing balance of 0.1 to 1000 g capacity was used for the measuring the weight of fruits. The measuring scale and tape were used for measurement of field width, field length and spatial dimension of existing

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trellis structure and of fruits. Load cell of 125 kg capacity and 0.1 to 0.2 % accuracy was used determine the load on the structure.

Crop Variety

1. Bottle gourd (Samrat)
2. Ridge gourd (Rekha)

Table 1
Material required for Bower Type Trellis System

Sr. No.	*Items*	*Dimensions*	*Quantity Required*
1	Bamboo	Length - 10ft Height - 6.5ft	3659
2	Nut and bolts	Length- 75mm Diameter- 0.5 cm	356
3	Mild steel strips	Width- 25mm Thickness-4mm	108
4	Nylon rope	Diameter - 3mm	144m
5	GI- Wire	14 gauge18 gauge	60m48m
6	Binding Wire	-	0.66kg
7	PVC Pipe	0.45m	36
8	Cement Concrete	-	0.20m^3

Crop were grown during Mansoon season. Crop parameter and harvested fruit parameters were recorded. Crop parameters viz number of flowers, number of fruits, stem thickness and number of fruits. After each harvesting, five fruits were selected randomly for observations of length, diameter and weight.

Table 2
Material required for T-Type Trellis System

Sr. No.	*Items*	*Dimensions*	*Quantity Required*
1	Bamboo	Length - 10ft and Height - 6.5ft	2727
2	Nut and bolts	Length- 75mm and Diameter- 0.5cm	162
3	Mild steel strips	Width - 25mm and Thickness- 4mm	54
4	Nylon rope	Diameter -3mm	144m
5	GI- Wire	14 gauge and 18 gauge	180m and 48m
6	Binding wire	-	0.66 kg
7	PVC Pipe	0.45m	27
8	Cement concrete	-	0.156m^3

Table 3
Material required for Vertical Type Trellis System

Sr. No.	*Items*	*Dimensions*	*Quantity Required*
1	Bamboo	Height - 6.5ft	36
4	Nylon rope	-	126m
5	GI- Wire	14 gauge	228m
		18 gauge	147m
6	Binding wire	-	660gm
7	PVC Pipe	0.45m	36
8	Cement concrete	-	0.20m^3

RESULTS AND DISCUSSIOIN

Crop parameters

Bottle gourd and Ridge gourd were grown on different developed type trellis system. The crops were grown in Monsoon season during July- October 2014. The observations on plant growth parameters were recorded. In all five plants were selected for study. Data recorded for Bower type trellis, "T"- type trellis vertical type trellis system and control system is presented in Table 4, Table 5 Table 6 and Table 7 respectively.

Table 4
Crop parameters for Bower Type Trellis System

Sr. No	*Week*	*RIDGE GOURD (REKHA)*				*BOTTLE GOURD (SAMRAT)*			
		No. of leaves	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*	*No. of leaves*	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*
1	First	20	-	4.70	-	14.4	-	8	-
2	Second	23	-	5.21	-	13.2	-	9.64	-
3	Third	32	7	6.76	-	20.0	4	11.88	-
4	Fourth	55	16	12.59	-	51.8	13	14.05	-
5	Fifth	76	26	14.69	-	51.8	26	14.32	2
6	Sixth	84	15	14.58	2	66.2	21	14.70	2
7	Seventh	89	15	15.00	2	76.8	20	15.04	3
8	Eight	97	16	15.60	3	89.6	16	16.44	2
9	Ninth	109	20	16.20	3	99.4	19	17.20	2
10	Tenth	122	22	16.20	3	124.4	20	17.22	3
11	Eleven	109	16	16.20	6	124.4	15	17.28	3
12	Twelve	83	13	15.20	6	88.0	15	16.60	5
13	Thirteen	56	15	14.00	6	51.0	15	15.80	6
14	Fourteen	36	11	12.80	4	35.0	11	14.80	5
15	Fifteen	22	7	13.00	3	22.6	6	12.20	3

Table 5
Crop parameters for T-Type Trellis System

Sr. No	*Week*	*RIDGE GOURD (REKHA)*				*BOTTLE GOURD (SAMRAT)*			
		No. of leaves	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*	*No. of leaves*	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*
1	First	15	-	4.68	-	14	-	8.40	-
2	Second	21	-	4.79	-	15	-	9.40	-
3	Third	31	7	6.50	-	19	4	11.85	-
4	Fourth	38	16	9.29	-	55	13	14.67	
5	Fifth	46	28	13.67	-	62	25	15.09	2
6	Sixth	61	18	14.46	2	66	23	14.91	2
7	Seventh	83	14	15.21	3	78	23	15.45	3
8	Eight	97	16	15.92	4	91	18	16.54	3
9	Ninth	120	19	16.32	3	99	21	17.10	4
10	Tenth	108	21	16.24	3	124	27	17.14	4
11	Eleven	79	17	16.48	4	89	22	17.29	4
12	Twelve	60	18	13.30	5	68	14	15.78	4
13	Thirteen	36	17	12.32	3	53	8	13.70	2
14	Fourteen	24	8	12.10	3	42	4	11.88	3
15	Fifteen	18	8	11.16	2	21	2	10.70	1

Table 6
Crop parameters for Vertical Type Trellis System

Sr. No	*Week*	*RIDGE GOURD (REKHA)*				*BOTTLE GOURD (SAMRAT)*			
		No. of leaves	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*	*No. of leaves*	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*
1	First	13	-	4.68	-	8	-	8.45	-
2	Second	24	-	5.67	-	14	-	9.67	-
3	Third	37	6	6.47	-	20	4	11.46	-
4	Fourth	59	22	11.83	-	54	12	14.25	-
5	Fifth	77	22	14.61		65	23	14.66	4
6	Sixth	87	20	15.41	2	67	20	15.14	4
7	Seventh	93	19	15.78	3	78	22	15.84	4
8	Eight	105	20	16.01	2	90	20	44.47	3
9	Ninth	123	21	16.10	4	103	22	17.14	3
10	Tenth	105	22	16.43	3	126	27	17.43	4
11	Eleven	84	21	16.48	4	113	26	17.61	3
12	Twelve	65	15	14.61	3	102	21	15.92	3
13	Thirteen	48	13	12.68	2	88	15	14.44	2
14	Fourteen	31	14	11.56	4	73	15	12.88	2
15	Fifteen	19	13	10.42	2	20	11	10.00	1

Table 7
Crop parameters for Control System

Sr. No	*Week*	*RIDGE GOURD (REKHA)*				*BOTTLE GOURD (SAMRAT)*			
		No. of leaves	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*	*No. of leaves*	*No. of flowers*	*Thickness of stem(mm)*	*No. of fruits*
1	First	16	-	4.71	-	9	-	8.56	-
2	Second	23	-	5.67	-	13	-	9.65	-
3	Third	32	7	6.56	-	22	5	11.56	-
4	Fourth	56	21	11.23	-	52	11	13.97	-
5	Fifth	74	22	13.61		68	21	14.76	5
6	Sixth	82	24	15.45	3	70	23	15.63	4
7	Seventh	94	20	16.10	3	71	24	25.84	6
8	Eight	104	22	16.67	4	89	22	43.47	4
9	Ninth	127	23	16.10	5	101	21	21.14	3
10	Tenth	101	20	16.56	3	123	25	17.43	4
11	Eleven	87	19	16.45	4	110	28	16.45	4
12	Twelve	69	14	15.61	2	94	19	15.67	3
13	Thirteen	44	12	12.68	2	85	14	13.45	3
14	Fourteen	34	13	11.72	3	71	15	12.45	2
15	Fifteen	17	10	10.34	2	25	10	11.10	2

HARVESTED FRUIT PARAMETERS

On developed Bower type trellis, "T"-type trellis and vertical type trellis cucurbits *viz* Bottle gourd (Samrat) and Ridge gourd (Rekha) were grown during July-Oct 2014. The observations for fruit dimensions were recorded. After each harvesting, five fruits were selected randomly for observations of length, diameter and weight. Table 8, table 9, table 10 and table 11 represents harvested fruit parameters data for bower type trellis, "T"- type trellis vertical type trellis and control syatem respectively.

Table 8
Harvested fruit parameters of Bower Type Trellis System

Sr. No	*Harvesting*	*Fruit parameters in Bower Type Trellis*					
		Bottle Gourd (Samrat)			*Ridge Gourd (Rekha)*		
		Length (cm)	*Diameter (cm)*	*Weight (gm)*	*Length (cm)*	*Diameter (cm)*	*Weight (gm)*
1	First	23.4	5.12	372.8	47.6	3.10	200.8
2	Second	29.0	5.59	530.0	49.6	3.42	200.8
3	Third	23.6	4.95	412.6	43.8	3.18	169.2
4	Fourth	28.8	5.01	572.0	47.6	3.30	179.0
5	Fifth	27.0	5.04	521.0	45.6	3.24	19.8
6	Sixth	25.0	5.24	436.0	42.6	3.22	14.2
7	Seventh	26.2	5.18	435.6	44.6	3.52	189.6
8	Eighth	27.6	5.48	452.0	49.2	3.40	200.0
9	Ninth	28.8	5.30	442.6	46.2	3.70	224.0
10	Tenth	26.2	5.33	416.8	45.2	3.64	218.0

Table 9
Harvested fruit parameters of T- Type Trellis System

Sr. No	*Harvesting*	*Fruit parameters in T-Type Trellis*					
		Bottle Gourd (Samrat)			*Ridge Gourd (Rekha)*		
		Length (cm)	*Diameter (cm)*	*Weight (gm)*	*Length (cm)*	*Diameter (cm)*	*Weight (gm)*
1	First	27.0	6.08	703	47.8	3.43	186.4
2	Second	24.2	5.99	520	47.2	3.55	197.8
3	Third	26.8	5.52	517	51.8	3.23	192.0
4	Fourth	23.6	5.57	443	48.8	3.33	178.2
5	Fifth	24.4	5.32	435	48.6	3.48	183.8
6	Sixth	24.8	5.54	424	44.6	3.42	203.4
7	Seventh	27.0	5.72	482	40.2	3.40	192.4
8	Eighth	26.4	5.35	431	37.2	3.38	171.4
9	Ninth	24.2	5.55	463	36.2	3.58	174.8
10	Tenth	25.8	5.28	427	36.8	3.40	162.8

Table 10
Harvested fruit parameters of Vertical Type Trellis System

Sr. No	*Harvesting*	*Fruit parameters in Vertical Type Trellis*					
		Bottle Gourd (Samrat)			*Ridge Gourd (Rekha)*		
		Length (cm)	*Diameter (cm)*	*Weight (gm)*	*Length (cm)*	*Diameter (cm)*	*Weight (gm)*
1	First	20.7	5.21	353.4	46.2	4.31	191.6
2	Second	26.5	6.02	651.4	44.8	3.65	172.8
3	Third	23.5	5.34	398.6	49.2	4.08	178.0
4	Fourth	24.4	5.40	505.8	42.0	3.49	146.4
5	Fifth	26.6	5.52	462.0	44.0	3.35	198.0
6	Sixth	24.0	5.64	438.0	42.8	3.55	170.4
7	Seventh	22.0	7.89	364.0	43.4	3.36	162.2
8	Eighth	23.2	5.48	399.6	41.8	3.61	168.4
9	Ninth	25.4	5.26	64.6.0	49.0	3.26	212.4
10	Tenth	23.6	5.40	432.0	33.2	3.50	167.4

Table 11
Harvested fruit parameters of Control System

Sr. No	Harvesting	Fruit parameters in Control System					
		Bottle Gourd (Samrat)			Ridge Gourd (Rekha)		
		Length (cm)	Diameter (cm)	Weight (gm)	Length (cm)	Diameter (cm)	Weight (gm)
1	First	21.6	6.02	521.2	45.3	4.51	192.4
2	Second	24.7	5.32	489.2	44.3	3.56	175.4
3	Third	22.5	6.12	423.1	48.4	4.17	177.4
4	Fourth	25.2	5.32	513.2	43.4	3.65	152.3
5	Fifth	25.8	5.57	476.4	45.2	4.10	194.3
6	Sixth	23.7	6.12	367.3	41.2	3.62	174.3
7	Seventh	22.5	6.97	387.0	42.0	3.45	165.3
8	Eighth	22.8	5.36	401.4	39.8	3.16	167.3
9	Ninth	24.7	5.45	563.2	47.4	4.10	191.3
10	Tenth	24.1	6.12	456.8	36.2	3.34	173.2

CROP LOAD

The crop load sustainability was calculated on the basis of actual load of crop on unit area. It is calculated by considering fruit load and vine load. The vine load was taken 15 % of total fruit load.

Table 12
Total crop load on different types of trellis system

Type of system	Total fruit load on area 30m* 3m (kg)	Total crop load(N/m^2)
Bower type trellis system	175.45	6.4
T- type trellis system	173.21	6.3
Vertical type trellis system	170.26	6.2
Control	171.32	6.3

CONCLUSIONS

1. Bower trellis system, T-trellis system and Vertical trellis system, was design and developed using bamboo as structural member.
2. Maximum design live load on structure was 100 N/m^2.
3. Maximum wind load trellis system was 123.35 N/m^2.
4. Ridge gourd and bottle gourd were cultivated on different types of trellis
5. Total fruit load on Bower trellis system, T-trellis system Vertical trellis system and control system was 6.4 N/m^2, 6.3 N/m^2, 6.2 N/m^2 and 6.3 N/m^2 respectively.

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