



## Comparative performance of King chilli (*Capsicum chinense* Jacq.) under naturally ventilated polyhouse and open field conditions for yield and earliness under agroclimatic conditions of Meghalaya

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### ABSTRACT

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A field study was carried out in King chilli (*Capsicum chinense* Jacq.) to evaluate the comparative performance of local lines viz., ML-1, ML-2, ML-3, ML-5, ML-6 and ML-7 under two growing environments viz., naturally ventilated polyhouse and open field conditions on the basis of their yield and other horticultural traits. The horticultural traits viz., no. of fruits per plant, fruit length, fruit breadth and average fruit weight was recorded higher under naturally ventilated polyhouse comparative to open field condition for all the six lines evaluated under the study. Early flowering was observed under naturally ventilated polyhouse cultivation resulting in early harvest in all the lines studied. Extended period of harvesting was also observed inside naturally ventilated polyhouse conditions for all the lines evaluated. The fruit yield per plant was also higher inside naturally ventilated polyhouse for all the lines evaluated. It was observed that the per centage increase in yield per plant under naturally ventilated polyhouse condition is highest in the line ML-7 (138.36%) followed by ML-3 (134.67%) and ML-5 (133.75%) over open field conditions. The line ML-5 (1.87kg) and ML-3 (1.76kg) recorded the highest yield inside naturally ventilated polyhouse. The B:C ratio for these highest yielding lines inside naturally ventilated polyhouse is 2.86 (ML-5) and 2.63 (ML-3). It was also observed that the line ML-6 perform significantly well under open field conditions as compare to the other lines under study. From the present study it can be concluded that cultivation of King chilli inside naturally ventilated polyhouse resulted in higher economic and quality yield with extended period of harvest. Thus, under the agroclimatic conditions of Meghalaya with unprecedented rainfall and extended monsoon, naturally ventilated polyhouse cultivation of King chilli may promise quality yield with higher net returns and may be popularized amongst the farmers of the region.

### 1. Introduction

King chilli (*Capsicum chinense* Jacq) is a species of capsicum which belongs to Solanaceae family and is one of the popular vegetables and spice crop grown successfully in North Eastern Region of India. It is widely popular in the region for its unique fruit with palatable aroma and high pungency. Attributed by its unique pungency and aroma, it has a huge potential in food, pharmaceutical and cosmetic industries. Amongst other horticultural crops, Capsicum species is considered to be suitable for cultivation under the agroclimatic condition of Meghalaya (Devi *et al.*, 2018). In

Meghalaya, due to prevalence of abiotic stresses such as heavy rainfall, low and high temperature and high relative humidity, there is more incidence of insect pest and diseases especially viral disease and shorter harvest duration of King chilli under open field conditions thus, resulting in lesser yield with low quality (Devi *et al.*, 2022). Under such conditions, protected cultivation may ensure more yield with premium quality produce as compare to that of open environment. Singh *et al.*, (2004) reported that cultivation of vegetables under protected structure such as polyhouses results in improvement of yield, quality and market value for

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the growers. It also offers opportunities to get vegetables beyond their normal growing season when the cultivation of the crop is not practical under open environment, resulting higher net returns per unit area. Many researchers have pointed out that off-season cultivation of vegetable crops *viz.*, tomato, chilli, bell pepper, cucurbits etc under protected structure is a successful and profitable venture in northern plains of India (Dixit, 2007). Through this technology farmers can fetch remunerative price for their higher quality produce under protected environment. Chemma *et al.*, (2004) also reported early harvest, higher gross yield and minimal incidence of diseases and pests under protected conditions. There is very limited information available on the comparative performance of King Chilli under protected and open field cultivations specifically for agroclimatic conditions of Meghalaya. Systematic research on this aspect is need of hour as King chilli has a great potential in this region. Keeping all this points under consideration, the present study was carried out with the efforts to assess the comparative performance of King Chilli under open and protected environments. This study will not only help in identifying the promising genotypes of King chilli suitable for protected cultivation but also identifies the genotype which are less sensitive to environment due to inherent characters and can perform well under both protected and open field conditions.

## 2. Material and Methods

The study was carried out at the Experimental Farm of Horticulture Section, DSRE, ICAR ( RC) for NEH Region, Umiam, Meghalaya under naturally ventilated polyhouse and open field conditions of farmer. The experiment was laid out in Randomized Block Design with three replications during 2021-22. The treatment comprises of six genotypes of King chilli *viz.*, ML-1, ML-2, ML-3, ML-5, ML-6 and ML-7. The experimental farm is located at an altitude of 950 m MSL with 25°41'N latitude and 91°54'E longitude. The location is categorized under subtropical climate. The area received an average annual rainfall of 150-250 cm. The period starting from April till September received 80% of the annual rainfall. The experimental plot is prepared after thorough ploughing keeping the bed at 20 cm height and 90 cm width. The plants were spaced at (1 × 1) m and (90 × 90) cm inter and intra row spacing under open field conditions and polyhouse condition, respectively. For recording data five plants of each entry were randomly taken. The observations recorded were yield and other horticultural traits *viz.*, days to first flowering, days to first harvest, harvest duration, fruit breadth (cm), fruit length (cm), plant height (cm), number of primary branches per plant, average fruit

weight (g), number of fruits per plant and average fruit yield per plant (kg). The data generated from the present study were statistically analysed as per the method described by Panse and Sukhatme (1985).

## 3. Results and discussion

The results on the performance of all the six lines of King Chilli under open field conditions and naturally ventilated polyhouse in respect to yield and other important traits of King chilli are presented in tables 1, 2 and 3.

### Plant growth and fruit characteristics

Plant growth and fruit characteristics such as plant height (cm), number of primary branches per plant, fruit length (cm) and fruit breadth (cm) were recorded under both the growing conditions (**Table 1**). It is observed from the following table that all these traits were significantly superior in naturally ventilated polyhouse conditions in comparison to open field conditions. The line ML-7 recorded the maximum plant height (164.11 cm) followed by ML-3 (153.21cm). However, in the open field conditions, the line ML-6 recorded the highest plant height (130.22cm). Mauer (1981) and Malshe *et al.*, (2016) also reported higher plant height in capsicum hybrids grown under protected environment as compare to open field. Similarly, the no. of primary branch per plant was also recorded higher inside naturally ventilated polyhouse for most of the lines except for ML-6 and ML-7 which recorded same no. of primary branches per plant in both the growing conditions. Rao *et al.*, (2013) also reported more no. of primary branches per plant in capsicum grown under shade net. The vigorous growth of the plants inside the protected structure for most of the lines may be due to enhanced photosynthetic activity thus making more assimilates available for vegetative growth of the plants. Fruit length and fruit breadth are important fruit characteristics that determine the appearance and quality of fruit in King chilli. Under naturally ventilated polyhouse environment, the maximum fruit length and fruit breadth was recorded in the line ML-5 (8.52cm) and ML-7 (3.42), respectively. The same line recorded the highest fruit length (ML-5; 6.13cm) and fruit breadth (ML-7; 1.55cm) in open field conditions also. The increase in fruit length and fruit breadth inside naturally ventilated polyhouse conditions may be due to the favourable microclimate prevailing inside the protected structure. Singh *et al.*, (2011) and Nkansah *et al.*, (2017) also reported higher fruit breadth and fruit length, respectively in capsicum under polyhouse cultivation.

**Table 1.** Comparative performance of king chilli lines under naturally ventilated polyhouse and open field environment for plant and morphological characteristics of fruit

S. No.	Genotype	Plant height (cm)		No. of primary branch/plant		Fruit length (cm)		Fruit breadth (cm)	
		LCP	OFC	LCP	OFC	LCP	OFC	LCP	OFC
1.	ML-1	102.32	72.35	5	4	7.38	5.31	2.75	1.42
2.	ML-2	108.63	85.71	4	3	6.25	3.52	2.31	1.35
3.	ML-3	153.21	120.13	5	4	7.36	5.22	3.25	1.47
4.	ML-5	132.30	112.11	4	4	8.52	6.13	2.86	1.44
5.	ML-6	133.60	130.22	5	5	6.82	4.79	2.78	1.41
6.	ML-7	164.11	126.51	5	5	6.90	4.88	3.42	1.55
	<b>Mean</b>	<b>132.36</b>	<b>107.83</b>	<b>4.67</b>	<b>4.16</b>	<b>7.20</b>	<b>4.97</b>	<b>2.89</b>	<b>1.44</b>
	<b>SE±</b>	1.97	1.45	0.35	0.33	0.12	0.16	0.12	0.02
	<b>CD at 5%</b>	5.95	4.33	0.52	0.49	0.35	0.32	0.07	0.06

**LCP:** Naturally ventilated polyhouse; **OFC:** Open field condition

#### Yield and its contributing traits

No. of fruits per plant and average fruit weight are important horticultural traits that directly contributes to yield per plant. The no of fruits per plant, average fruit weight and yield/plant recorded under both the growing conditions are presented in **Table 2**. The study reveals comparatively more no. of fruits/plant, bigger fruit size and yield/plant under naturally ventilated polyhouse conditions than open field condition for all the lines studied. The no. of fruits/plant was highest in ML-2 (183) followed by ML-1 (178) under polyhouse condition. The average fruit weight was found to be highest in ML-5 (12.72g) under polyhouse condition followed by ML-3 (12.03g). Higher average fruit weight was observed by Mohamedien (1991) and Naik (2005) in cucumber and capsicum, respectively under protected structure. The present study also revealed signifiably higher average fruit yield/ plant inside naturally ventilated polyhouse for all the lines studied as compared to open field environment. The percentage increase in average fruit weight per plant over open field conditions was recorded highest in the line ML-7 (107.34%) followed by ML-5 (104.40%). The overall increase in average fruit weight inside polyhouse conditions were high in all the lines studied. Similarly, it was observed that the average yield per plant for all the lines

studied was higher inside naturally ventilated polyhouse conditions as compare to open field environment. The line ML-5 (1.87 kg) recorded the highest average yield per plant followed by ML-3 (1.76 kg) inside naturally ventilated polyhouse condition. The line ML-3 (138.86%) recorded the highest per centage increase of average yield per plant over open field conditions. This indicate that King chilli when grown under protected cultivation can ensure higher quality yield with bigger size fruit which are important traits from market point of view. The study also reveals significant percentage increase in yield over open field conditions in all the lines under study indicating that naturally ventilated polyhouse cultivation of King chilli can promise higher yield. From the result of the study, it was also observed that the line ML-6 recorded least percentage increase in yield (66.67%) over open field conditions. This indicates that this particular line is less sensitive to environment and could be a good genotype for open field condition. Kanwar *et al.*, (2014), Nkansah *et al.*, (2017), Brar *et al.*, (2005) in capsicum; Singh *et al.*, (2004) in summer squash; Chandra *et al.*, (2000) and Singh *et al.*, (2010) also reported more no. of fruits/plant and yield/plant inside polyhouse conditions.

**Table 2.** Comparative performance of king chilli lines inside naturally ventilated polyhouse and open field environment for yield and contributing traits

S. No.	Genotype	No. of fruits/plant		Average fruit weight (g)			Average Yield/plant (Kg)		
		LCP	OFC	LCP	OFC	Percent increase over open field	LCP	OFC	Percent increase over open field
1.	ML-1	178	150	9.55	5.33	79.17	1.70	0.80	112.50
2.	ML-2	183	163	9.33	5.12	73.82	1.53	0.69	121.73
3.	ML-3	143	123	12.30	6.11	101.30	1.76	0.75	134.67
4.	ML-5	147	129	12.72	6.22	104.40	1.87	0.80	133.75
5.	ML-6	165	155	10.30	6.58	56.53	1.70	1.02	66.67
6.	ML-7	158	137	11.01	5.31	107.34	1.74	0.73	138.36
	<b>Mean</b>	<b>162.33</b>	<b>142.83</b>	<b>10.87</b>	<b>5.78</b>	-	<b>1.72</b>	<b>0.80</b>	-
	<b>SE±</b>	3.55	2.65	1.43	1.03	-	0.02	0.01	-
	<b>CD at 5%</b>	10.33	9.21	2.05	1.62	-	0.06	0.04	-
	<b>Paired t</b>	17.45*		3.59*		-	6.25*		-

*LCP: Naturally ventilated polyhouse; OFC: Open field condition*

*(\*significant at 5.0%)*

#### Earliness and harvest duration

The cultivation of King chilli under naturally ventilated polyhouse resulted in early flowering and early harvest with extended harvest duration for all the lines under study (Table 3). Rao *et al.*, (2013) also reported similar finding. The line ML-5 was the earliest to flower and harvest with days to first flowering (46.23 days) and days to first harvest (59.18 days). Yellavva (2008) also reported early harvesting in capsicum grown under polyhouse as compare to open field cultivation. It was also observed that all the lines under evaluation showed extended harvest duration (210 days) under naturally ventilated polyhouse and the crop continue to give economic yield upto 7 months from first harvest. However, in open field conditions economic yield

could be harvested only upto 4 months (120 days) in all the lines, after which there was less fruiting and small size fruit with less market value. Early harvesting and extended harvest duration in capsicum under protected cultivation was also reported by Singh and Asrey (2005), Singh *et al.*, (2011) and Kanwar *et al.*, (2014). The extended harvest duration inside naturally ventilated polyhouse may be due to protection from abiotic stresses such as heavy rainfall leading to water logging and less incidence of viral diseases which are very common in open field cultivation. Thus, from the present study, it could be concluded that through protected cultivations, growers can get early crop and hence earn remunerative price and higher net return as compare to open field condition.

**Table 3.** Comparative performance of king chilli lines inside naturally ventilated polyhouse and open field environment for earliness and duration of harvest

S. No.	Genotype	Days to first flowering		Days to first harvest		Harvest duration	
		LCP	OFC	LCP	OFC	LCP	OFC
1.	ML-1	53.45	63.28	90.03	120	121	120
2.	ML-2	57.66	67.56	92.23	126	121	120
3.	ML-3	48.65	61.73	90.03	116	121	120
4.	ML-5	46.23	59.18	86.55	112	121	120
5.	ML-6	54.35	60.86	90.45	120	121	120
6.	ML-7	49.73	60.66	89.33	115	121	120
	<b>Mean</b>	<b>51.68</b>	<b>62.21</b>	<b>89.77</b>	<b>118.17</b>	<b>121</b>	<b>120</b>
	<b>SE±</b>	0.46	0.49	0.68	0.71	-	-
	<b>CD at 5%</b>	1.66	1.69	2.01	1.95	-	-

*LCP: Naturally ventilated polyhouse; OFC: Open field condition*

#### Benefit: Cost ratio

The economics of production of King chilli inside naturally ventilated polyhouse was estimated keeping into account the fixed and variable costs involved in the production of the crop (Table 5). The benefit: cost ratio (Table. 4) was highest in the line ML-5 (2.86) followed by ML-3 (2.63). The benefit: cost ratio for all the lines was higher than 1 indicating that cultivation of the crop inside naturally ventilated polyhouse will ensure a profitable venture with higher net returns for the farmers.

**Table 4.** Economics of King chilli (*Capsicum chinense* Jacq.) under naturally ventilated polyhouse (area = 250 m<sup>2</sup>)

Line/Genotypes	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
ML-1	74550	2,61,800	187250	2.51
ML-2	74550	2,35,620	161070	2.16
ML-3	74550	2,71,040	196490	2.63
ML-5	74550	2,87,980	213430	2.86
ML-6	74550	2,61,800	187250	2.51
ML-7	74550	2,67,960	193410	2.59

(\* B:C = Net Return/Total cost of cultivation; Sale price of fruit @ Rs. 500/kg)

**Table 5.** Cost of cultivation of King chilli under 250 m<sup>2</sup> naturally ventilated polyhouse

Sl. No.	Cost head	Amount (Rs.)
1.	Polyhouse cost (area 250 m <sup>2</sup> )	2,50,000/-
	Average life of polyhouse	5 years
	Polyhouse cost per year	50,000/-
2.	Labour charge (45 man days, @Rs 350/-)	15750/-
	Cost of bed preparation	10 man days
	Cost of transplanting and irrigation	10 man days
	Cost of interculture operations	20 man days
	Harvesting	5 mandays
3.	Cost of seed material	800/-
4.	Cost of manure, fertilizer, biopesticides	8000/-
	<b>Total cost of cultivation</b>	<b>74,550/-</b>

#### 4. Conclusion

It may be concluded from the present study that under the agroclimatic conditions of Meghalaya with unprecedented rainfall and extended monsoon the cultivation of King chilli inside protected structure such as naturally ventilated polyhouse enhanced the crop duration, yield as well as earliness with improve fruit quality as compares to open field cultivation. The economics of production for cultivation under naturally ventilated polyhouse also reveals that benefit: cost ratio for all the lines under study ranged from 2.16 to 2.86 and ensures high net returns per unit area. Thus, it can be concluded that protected structure considerably enhanced the production, earliness and quality of King chilli as compared to open field conditions, and hence this technology should be encouraged particularly amongst the farmers of Meghalaya where the agroclimatic conditions is characterized by unprecedented rainfall and extended monsoon.

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