# Evaluation of hybrids and parents of chilli (*Capsicum annuum* L.) for yield and resistance to chilli leaf curl virus

Comment [T1]: What is the fundamental difference between your research and previously done paper with the same title. P Nivedha et al, 2019??

Comment [T2]: Green highlighted parts of the manuscript indicates the plagiarized content.

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## Abstract

Chilli (*Capsicum annuum* L.) is one of the most important commercial vegetable, cum spice crops that belongs to family Solanaceae.Leaf curl virus disease is a most destructive threat to chilli production which adversely affect yield. Twenty four $F_1$ hybrids were developed by crossing eleven diverse parents in line x tester mating design and were screened for ~~yield,yield~~yield, yield related traits and for resistance to leaf curl virus under natural epiphytotic condition and artificial inoculation using viruliferous white flies at College of horticulture, Bagalkot (University of horticulture science, Bagalkot) during 2021-2023. The analysis of variance indicated the presence of significant variation among the chilli hybrids and parents for the characters observed and reaction to disease. Based on the *per se* performance, the hybrid ByadgiDabbi x IC284628 recorded the highest individual fruit weight, hybrid ByadgiKaddi x Punjab Sindhuri observed highest number of fruits per plant and hybrid ByadgiKaddi x Punjab Lal recorded highest green fruit yield per plant among all the hybrids. The hybrids ByadgiKaddi x Punjab Surkh, ByadgiDabbi x Punjab Surkh,

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ByadgiDabbi x Punjab Sindhuri and ByadgiKaddi x Punjab Sindhuri were found to have higher tolerance to chilli leaf curl disease.

**Keywords**: Hybrids, Chilli leaf curl virus, Yield, Resistance, Parents, Heterosis

**Introduction**

Chilli (*Capsicum annuum* L.) is a most important commercially exploited crop popularly called hot pepper or red pepper belongs to family Solanaceae (nightshade) and origins back to tropical America (Sood*et al.,* 2011). The name *Capsicum* is derived from Latin word "*Capsa*" which means "hallow pod." *Capsicum* genus has wide diversity in plant and fruit characteristics, which make it extremely versatile and suitable for innumerable uses.It is reported as an essential industrial crop, with pungency (capsaicin) being an important pharmaceutical property and also used in the food industry as a colouring agent for colouring a processed food, hence it is major cash crop which is exclusively grown in tropical and sub-tropical countries.India is the world leader in chilli production followed by China, Thailand, Ethiopia and Indonesia. India is the largest producer, consumer and exporter of chilli, accounting for more than 36.57% of the World's total dry chilli production (Geethaand Selvarani 2017). Important states growing chilli are Andhra Pradesh, Telangana, Karnataka, Orissa, Maharashtra, West Bengal, Rajasthan and Tamil Nadu. Karnataka ranks second with an area of 48.25 thousand hectares, production of 615.25 thousand MT and productivity of 12.75 MT/ha (Anonymous, 2022).Total production of dry chilli in Karnataka is drastically decreased by 59.7 per cent in last 10 years *i.e.* from 1998-99 (1.29 lakh ha) to 2009-10 (0.52 lakh ha) (Stephan *et al.*, 2016). This reduction in area of dry chilli production is mainly due to several biotic stresses especially caused by virus. It is reported that chilli is attacked by more than 65 viruses (Nigam *et al.,* 2015).

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The yield of chilli crop is adversely affected due to leaf curl disease, caused by chilli leaf curl virus (Kumar *et al.,* 2015) belonging to genus Begomovirus and family Geminiviridae (Rai*et al.,* 2014). The white fly (*Bemisiatabaci*) acts as a vector for the transmission of virus into the host plant. The symptoms of the disease include stunting of plant growth, upward curling of leaves, puckering, rosette appearance of the leaves on the top of the plant, reduced internodes and petioles, thickening of veins. The older leaves become leathery and brittle and the affected plant fails to produce flowers and fruits (Sinha *et al.*, 2011, Srivastava *et al.*, 2021). The reduction in yield of chilli due to leaf curl disease may extend up to 100 per cent thus causing a great loss to the farmers (Senanayake*et al.,* 2007;

Zehra*et al.*, 2010). Among the various management techniques available to check this viral disease in chilli, the most efficient way is by controlling the vector population using systemic insecticides but it makes chilli cultivation costly and hazardous to human health and environment. On the other hand, growing of chilli varieties/ hybrids with resistant to leaf curl disease will serve as a simplest and convenient method to the farmers to control the disease and pave way to reduce the yield loss, cost of cultivation and enables an eco-friendly cultivation. Therefore, the present study was conducted to identify the high yielding hybrids combined with resistance to leaf curl disease among twenty-four $F_1$ hybrids developed utilizing eleven parents through line x tester mating design.

**Materials and methods**

The present investigation about the evaluation of chilli hybrids and parents for yield, yield related traits and resistance to chilli leaf curl virus at College of horticulture Bagalkot (University of Horticulture Science, Bagalkot) during 2020-2023. The experimental material consist~~sing~~ of 24 hybrids and 11 parents during 2020-21. Based on the genotypic reaction for leaf curl virus resistance, the resistant lines were used as donor parents to transfer the virus resistance to the popular Byadgi varieties. Total eight resistant genotypes and three susceptible parents were used for crossing in line × tester fashion as suggested by Kempthorne (1957) to produce twenty-four $F_1$ hybrids. The experiment was laid out in Randomised Block Design with two replications and a standard check. Seedlings of chilli hybrids and parents were raised in protrays and 35 days old seedlings were transplanted at a distance of 60 x 45 cm in the month of February during the summer season. The experimental site and season were found to be favourable for white fly build up in the past years (Sirawata and Karcho 2023). All the cultural practices were followed as per package of practice of UHS, Bagalkot.

**Table 1.Details of chilli lines, testers and commercial check used in the study**

| Sl. No. | Entry | Genotypes |
|---|---|---|
| | **Lines** | |
| 1. | L1 | ByadgiDabbi |
| 2. | L2 | ByadgiKaddi |
| 3. | L3 | Sankeshwar |
| | **Testers** | |
| 1. | T1 | EC391087 |
| 2. | T2 | IC342426 |
| 3. | T3 | IC342464 |
| 4. | T4 | IC284628 |

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**Comment [T3]:** There is no site description, soil type temperature, rain fall conditions, since these factors are highly affect the performance of the target genotypes.

**Comment [T4]:** Why you need to use the susceptible parents? You can use as a check in trial evaluation however, it is not important to include susceptible parent in crossing.

**Comment [T5]:** Use the standard table format!

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| 5. | T5 | Punjab Lal |
| 6. | T6 | Punjab Tej |
| 7. | T7 | Punjab Sindhuri |
| 8. | T8 | Punjab Surkh |
| | **Commercial check** | |
| 1. | CC | Sarphan hybrid 102 |

**Observations recorded**

Five plants in each entry in each replication were randomly selected, tagged and the following observations were recorded from the tagged plants. The data on growth, yield and yield related parameters *viz*., plant height, number of primary branches per plant, number of secondary branches per plant, number of fruits per plant, fruit length, fruit width, individual green fruit weight and green fruit yield per plant. Per cent of disease infection and disease severity under natural field conditions and artificial screening under mass inoculation were recorded based on the scales for classifying leaf curl disease reactions as developed by Kumar *et al.,* (2006). From the recorded observation percent disease incidence (PDI) was calculated. The data on scoring value of chilli leaf curl disease were subjected to suitable statistical analysis, and the hybrids were categorized into six categories based on methods adopted by Reddy *et al.* (2001)

**Comment [T6]:** Elaborate how you measure and record these parameters. Reference!

**Percent disease incidence (PDI)**: The incidence of leaf curl virus was calculated by using the following formula developed by (Kumar *et al.*, 2006) and statistically analysed.

$$\text{Percent disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

**Table 2: Indexing of leaf curl virus in chilli**

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| Symptom severity grade | Symptoms | Reaction (%) | Category |
|---|---|---|---|
| 0 | No symptom | 0 | Immune |
| 1 | 0-5% Curling and clearing of upper leaves | 1 – 10 | Highly Resistant |
| 2 | 6-25% Curling, clearing of leaves and swelling of veins | 11 – 25 | Resistant |
| 3 | 26-50% Curling, puckering and yellowing of leaves and swelling of veins | 26 – 40 | Moderately Resistant |

| | | | |
|---|---|---|---|
| 4 | 51-75% leaf curling and stunted plant growth and blistering of internodes | 41 – 60 | Susceptible |
| 5 | >75% curling and deformed small leaves, stunted plant growth with small flowers and no or small fruit set | >60 | Highly Susceptible |

Comment [T7]: Use standard table format

**Results and discussion**

Based on the genotypic reaction for leaf curl virus resistance, the resistant lines identified during previous experimentswere used as donor parents to transfer the virus resistance to the popular Byadgi varieties. These hybrids were tested for leaf curl virus resistance in the natural field condition in the hot spot area and artificial screening under mass inoculation, which are the best measures to know the resistance or tolerance against virus. The phenotypic reactions of host plants were recorded in terms of symptomatic expression following a disease scoring scale (0-5) given by (Banerjee and Kallo, 1987 and Kumar *et al.*, 2006). The analysis of variance for various characters observed in chilli parents and hybrids under the study are presented in the table 3. The analysis of variance indicated the presence of significant variation among the hybrids for characters under study. The mean performance of the parents and hybrids for yield and yield related characters are presented in table 4.

Comment [T8]: Put this in materials and methods!

**Plant height**

Heterosis for plant height traits is directly related to yield as the growth and yield parameter are strongly associated for increased production.The *per se* range for plant height of 41.43 cm (ByadgiKaddi x IC342426) to 125.83 cm (Shankeshwar x IC342464) was recorded by $F_1$ hybrids as compared to parents 50.99 cm (IC342426)– 89.07 cm (IC342464) and check (63.55 cm). Wide range of heterosis was exhibited by $F_1$ hybrids for plant height.Similar results were also reported by Rekha*et al.* (2016), Abrham*et al.* (2017), Rao *et al.* (2017) and Rohini and Lakshmanan (2017).

**Number of primary branches**

Primary branches are the essential growth parameter which acts as source for supporting yield and its component traits. The parents showed the variation from 3.21 (Punjab Tej) – 5.06 (EC391087) for number of primary branches whereas, the hybrid crosses had the range from 3.60 (ByadgiDabbi x IC342464) – 6.62 (Shankeshwar x EC391087). For number of

primary branches, positive heterosis was noticed in majority of the crosses.These results are in agreement with Rekha*et al*. (2016), Rao *et al.* (2017) and Rohini and Lakshmanan (2017), Thilak*et al.* (2017), Vijeth*et al.* (2019) and Aiswarya*et al.* (2020).

**Number of secondary branches**

The number of secondary branches is important as the fruits are borne on the axils of secondary branches which directly favours to number of fruits per plant. The parents showed the variation for number of secondary branches which ranged from 6.90 (Punjab Tej) - 11.59 (EC391087) whereas, among the $F_1$ hybrid crosses it ranged from 7.01 (ByadgiDabbi x IC342464) – 14.17 (Shankeshwar x IC342426).These findings are in conformity with those of Gawali*et al.* (2015), Rekha *et al.* (2016) and Rao *et al.* (2017).

**Number of fruits per plant**

Number of fruits per plant is the most important primitive component which directly influence the fruits yield. Heterosis for yield is mainly attributed to heterosis for number of fruits per plant. The parents varied from 42.67 (ByadgiDabbi) to 174.49 (Punjab Sindhuri) for number of green fruits per plant. Among $F_1$ hybrids number of fruits per plant ranged from 41.30 (Shankeshwar x IC342464) to 166.31 (ByadgiKaddi x Punjab Sindhuri). These results are in conformity with work of Patel *et al.* (2015), Spaldon*et al.*, (2015), Gawali*et al*. (2015), Reka*et al.* (2016), Rao *et al.* (2017) and Mopidevi*et al.* (2017), Thilak*et al.* (2017), Ganefianti and Fahrurrozi (2018), Chakrabarty*et al.*(2019), Vijeth*et al.* (2019) and Aiswarya*et al*. (2020).

**Fruit weight**

Mean values for fruit weight among chilli genotypes varied significantly from 6.98 g (EC391087) to 19.54 g (ByadgiDabbi) for parents while, the $F_1$ crosses varied from 5.24 g (Shankeshwar x EC391087) to 14.78 g (ByadgiDabbi x IC284628). With respect to average fruit weight, the magnitude of heterosis over commercial check11.08 g. These results are in agreement with those of Abrham*et al.* (2017), Rao *et al.* (2017), Rohini and Lakshmanan (2017), Mopidevi*et al.* (2017), Ganefianti and Fahrurrozi (2018) and Nikornpun*et al.* (2020).

**Fruit length**

Fruit length is one of the important yield parameters, which directly contributes to the fruit weight, thereby affecting the total yield. A critical analysis of the data for this trait shows the

enormous variation among the parents, hybrids and standard check. The parents varied from 4.23 cm (EC391087) to 22.77 cm (Shankeshwar) for fruit length. Among $F_1$ hybrids fruit length ranged from 5.11 cm(ByadgiDabbi x EC391087) to 18.35 cm (Shankeshwar xIC284628).The results are in line with the work ofSavitha*et al.* (2015), Spaldon*et al.* (2015), Naresh*et al.* (2016), Abrham*et al.* (2017),and Vijeth*et al.* (2019).

**Fruit width**

In the trait fruit width mean values among chilli genotypes varied significantly from 0.69 cm (Shankeshwar) to 2.22 cm (EC391087) for parents and among the $F_1$ hybrid crosses it varied from 0.58 cm (Shankeshwar x Punjab Sindhuri) to 2.02 cm (ByadgiDabbi x EC391087).Similar results were obtained by Mopidevi*et al.* (2017), Silva *et al.* (2017), Shumbulo*et al.* (2018), Ganefianti and Fahrurrozi (2018) and Vijeth*et al.* (2019).

**Green fruit yield**

The fruit yield is the ultimate requirement for the farmers for attaining effective economic profit. The average fruit yield per plant varied from 440.76 g (EC391087) to 1413.44 g (Punjab Surkh) among parents and 340.74 g (Shankeshwar x EC391087) to 1686.92 g (ByadgiKaddi x Punjab Lal) within $F_1$ hybrid crosses.These results are in agreement with the works of Rao *et al.* (2017), Mopidevi*et al.* (2017), Chakrabarty*et al.* (2019), Vijeth*et al.* (2019) and Nikornpun*et al.*(2020).

The per cent disease index and disease reaction of all the chilli hybrids and genotypes are presented in the table 5. There was high phenotypic variation for leaf curl virus disease incidence among chilli hybrids and parents in both natural and artificial screening. PDI during natural screening ranged from 4.50% (Punjab Lal) to 99.50% (ByadgiDabbi) among parents and it ranged from 14% (ByadgiKaddi x Punjab Surkh) to 88% (Shankeshwar x IC284628) among chilli hybrids. During artificial screening PDI ranged from 8% (Punjab Lal) to 99% (ByadgiKaddi) among parents and it ranged from 17% (ByadgiKaddi x Punjab Surkh) to 82% (Shankeshwar x EC391087) among hybrids.The variation in virus incidence among different genotypes may be due to tolerance of differential load of virus infection based on the morphological, biochemical or nutritional factors which act as a defence mechanism against the virus infection.The chilli hybrids and parents were categorized into 6

groups based on their reaction to leaf curl virus and the data is presented in the table 6. From per cent disease incidence,it is evident that hybrid ByadgiKaddi x Punjab Surkh and ByadgiDabbi x Punjab Surkh were found to be resistant to leaf curl virus showing least PDI compared to other hybrids in both natural and artificial screening.Parents EC 391087, Punjab Lal, Punjab Surkh was observed to be highly resistant to leaf curl virus in both natural and artificial screening.Similar results were observed by (Ahmad *et al.,* 2016, Dhaliwal *et al.,* 2013, Awasthi and Kumar 2008)

**Table 3: Analysis of variance (mean sum of squares) for yield, yield related traits and disease resistance in chilli**

| Sl. No. | Characters | Replication | Genotypes | Parents | Parents (Line) | Parents (Tester) | Parents (L vs T) | Parents vs Crosses | Crosses | Error |
|---|---|---|---|---|---|---|---|---|---|---|
| | d.f. | 1 | 34 | 10 | 2 | 7 | 1 | 1 | 23 | 34 |
| | Parameters | | | | | | | | | |
| 1 | Plant height | 41.56 | 947.56*** | 225.03** | 66.65* | 301.58*** | 5.92 | 45.76 | 1300.91*** | 24.34 |
| 2 | No. of primary branches | 0.06 | 1.16*** | 0.70*** | 0.24*** | 0.93*** | 0.05 | 4.97*** | 1.13*** | 0.11 |
| 3 | No. of secondary branches | 0.05 | 9.79*** | 5.19*** | 2.05* | 6.75*** | 0.55 | 19.41*** | 11.37*** | 0.43 |
| 5 | No. of fruits per plant | 110.35 | 2533.12*** | 3945.23*** | 570.42*** | 3932.19*** | 10786.08** | 23.15*** | 2028.29*** | 192.64 |
| 6 | Fruit weight | 0.02 | 22.39*** | 38.81*** | 17.98** | 31.16*** | 134.03** | 12.63*** | 15.67*** | 2.57 |
| 7 | Fruit length | 0.18 | 30.30*** | 50.01*** | 48.21*** | 22.86*** | 243.75*** | 6.75*** | 22.75*** | 0.62 |
| 8 | Fruit width | 0.00 | 0.45*** | 0.46*** | 0.77*** | 0.43*** | 0.03* | 0.77*** | 0.42*** | 0.01 |
| 9 | Green fruit yield | 19001.41 | 276081.18*** | 165275.41*** | 25143.71*** | 203584.56** | 177374.77*** | 43863.19*** | 334354.03*** | 7799.50 |
| 11 | Disease incidence | 15.56 | 1727.78*** | 3112.10*** | 2.00 | 131.42*** | 30197.06*** | 1021.59*** | 1156.61*** | 22.88 |

* indicates significance of values at p = 0.05, ** indicates significance of values at p = 0.01

***indicates significance of values at p = 0.001



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**Comment [T9]:** Use the standard table across the manuscript.

**Table 4: Estimation of *per se* performance of parents and hybrids for yield, yield related parameters and disease resisance in chilli**

| Sl.No. | Genotypes | Plant height (cm) | No. of primary branches | No. of secondary branches | No. of fruits per plant | Fruit weight (g) | Fruit length (cm) | Fruit width (cm) | Green fruit yield (g/plant) |
|---|---|---|---|---|---|---|---|---|---|
| Parents | | | | | | | | | |
| 1 | ByadgiDabbi | 67.69 | 3.63 | 7.80 | 42.67 | 19.54 | 13.03 | 1.92 | 829.09 |
| 2 | ByadgiKaddi | 75.60 | 4.19 | 9.19 | 55.62 | 18.23 | 19.01 | 1.49 | 1018.34 |
| 3 | Shankeshwar | 78.93 | 4.25 | 9.77 | 76.16 | 13.82 | 22.77 | 0.69 | 1027.91 |
| 4 | EC391087 | 61.53 | 5.06 | 11.59 | 63.13 | 6.98 | 4.23 | 2.22 | 440.76 |
| 5 | IC342426 | 50.99 | 4.96 | 11.10 | 65.34 | 16.79 | 13.66 | 1.44 | 1099.63 |
| 6 | IC342464 | 89.07 | 3.50 | 7.00 | 85.29 | 12.54 | 11.89 | 1.12 | 1071.91 |
| 7 | IC284628 | 73.53 | 4.10 | 8.85 | 77.13 | 17.54 | 15.16 | 1.62 | 1271.82 |
| 8 | Punjab Lal | 72.46 | 4.16 | 10.02 | 96.13 | 12.53 | 9.73 | 0.93 | 1204.42 |
| 9 | Punjab Tej | 81.02 | 3.21 | 6.90 | 161.87 | 8.66 | 10.50 | 0.99 | 1390.52 |
| 10 | Punjab Sindhuri | 71.07 | 4.49 | 10.66 | 174.49 | 7.95 | 8.72 | 0.77 | 1388.00 |
| 11 | Punjab Surkh | 83.61 | 3.57 | 8.09 | 139.56 | 10.23 | 12.48 | 1.20 | 1413.44 |
| 12 | Standard Check | 63.55 | 3.64 | 8.86 | 75.81 | 11.08 | 11.73 | 1.11 | 839.48 |
| Hybrids | | | | | | | | | |
| 1. | BD x EC391087 | 51.05 | 4.80 | 12.38 | 52.78 | 7.25 | 5.11 | 2.02 | 382.71 |
| 2. | BD x IC342426 | 42.96 | 5.72 | 13.23 | 73.54 | 14.23 | 14.92 | 1.42 | 1041.10 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3. | BD x IC342464 | 115.38 | 3.60 | 7.01 | 50.07 | 13.85 | 12.65 | 0.84 | 691.58 |
| 4. | BD x IC284628 | 43.85 | 5.76 | 13.43 | 81.90 | 14.78 | 15.49 | 1.72 | 1210.40 |
| 5. | BD x PL | 68.01 | 4.47 | 10.61 | 118.37 | 13.70 | 10.54 | 0.72 | 1604.92 |
| 6. | BD x PT | 60.44 | 4.62 | 11.32 | 112.23 | 13.01 | 10.99 | 0.77 | 1432.99 |
| 7. | BD x PS | 76.47 | 4.30 | 8.80 | 109.83 | 12.20 | 8.70 | 0.66 | 1313.27 |
| 8. | BD x PSU | 89.75 | 4.15 | 7.73 | 117.55 | 13.32 | 12.81 | 1.10 | 1544.58 |
| 9. | BK x EC391087 | 53.57 | 4.76 | 12.10 | 62.03 | 6.53 | 6.15 | 1.91 | 403.54 |
| 10. | BK x IC342426 | 41.43 | 5.60 | 12.87 | 85.03 | 14.10 | 16.06 | 1.24 | 1184.19 |
| 11. | BK x IC342464 | 120.28 | 3.86 | 7.26 | 69.11 | 13.80 | 12.92 | 0.78 | 923.85 |
| 12. | BK x IC284628 | 48.61 | 4.89 | 12.62 | 86.77 | 14.52 | 16.88 | 1.61 | 1242.76 |
| 13. | BK x PL | 73.96 | 4.30 | 9.04 | 124.66 | 13.62 | 11.11 | 0.68 | 1686.92 |
| 14. | BK x PT | 57.55 | 4.65 | 11.58 | 114.36 | 12.79 | 11.62 | 0.76 | 1460.49 |
| 15. | BK x PS | 80.98 | 4.29 | 8.49 | 166.31 | 8.11 | 9.05 | 0.60 | 1347.66 |
| 16. | BK x PSU | 93.49 | 4.76 | 7.62 | 119.88 | 13.17 | 13.03 | 0.94 | 1578.13 |
| 17. | SWRxEC391087 | 56.34 | 6.62 | 11.74 | 65.06 | 5.24 | 7.71 | 1.83 | 340.74 |
| 18. | SWRxIC342426 | 46.45 | 4.05 | 14.17 | 71.14 | 14.02 | 17.05 | 1.17 | 996.94 |
| 19. | SWRxIC342464 | 125.83 | 6.02 | 7.59 | 41.30 | 13.71 | 13.05 | 0.78 | 564.81 |
| 20. | SWRxIC284628 | 45.67 | 4.31 | 13.45 | 84.82 | 14.28 | 18.35 | 1.53 | 1200.50 |
| 21. | SWR x PL | 71.34 | 4.40 | 9.30 | 113.33 | 13.39 | 12.56 | 0.67 | 1503.63 |
| 22. | SWR x PT | 64.55 | 4.26 | 9.73 | 108.19 | 12.76 | 12.58 | 0.75 | 1380.14 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 23. | SWR x PS | 86.13 | 3.96 | 8.13 | 150.85 | 8.53 | 9.59 | 0.58 | 1286.43 |
| 24. | SWR x PSU | 101.56 | 4.76 | 7.34 | 114.05 | 13.10 | 13.07 | 0.90 | 1493.67 |
| | **S.Em ±** | **3.12** | **0.24** | **0.46** | **9.72** | **1.15** | **0.55** | **0.06** | **61.66** |
| | **C.D. at 5%** | **8.95** | **0.68** | **1.33** | **27.92** | **3.30** | **1.59** | **0.16** | **177.03** |
| | **C.D. at 1%** | **12.01** | **0.91** | **1.78** | **37.46** | **4.43** | **2.13** | **0.22** | **237.53** |

Where: CD – Critical difference, S.Em ± - Standard error of mean

BD – ByadgiDabbi, BK – ByadgiKaddi, SWR – Sankeshwar, PL – Punjab Lal, PT – Punjab Tej, PS – Punjab Sindhuri, PSU – Punjab Surkh

**Table 5: Screening of chilli hybrids and their parents for resistance to leaf curl virus under natural epiphytotic condition**

| Sl. No | Chilli hybrids | Natural screening | | Artificial screening | |
|---|---|---|---|---|---|
| | | Per cent disease index (%) | Disease reaction | Per cent disease index (%) | Disease reaction |
| 1 | BD x EC391087 | 54.00 | S | 57.00 | S |
| 2 | BD x IC342426 | 66.00 | HS | 69.00 | HS |
| 3 | BD x IC342464 | 74.00 | HS | 70.00 | HS |
| 4 | BD x IC284628 | 78.00 | HS | 68.00 | HS |
| 5 | BD x PL | 57.50 | S | 51.00 | S |
| 6 | BD x PT | 29.00 | MR | 32.00 | MR |
| 7 | BD x PS | 25.00 | R | 22.00 | R |
| 8 | BD x PSU | 21.50 | R | 24.00 | R |
| 9 | BK x EC391087 | 49.00 | S | 53.00 | S |
| 10 | BK x IC342426 | 36.00 | MR | 42.00 | MR |
| 11 | BK x IC342464 | 59.00 | S | 62.00 | HS |
| 12 | BK x IC284628 | 68.00 | HS | 73.00 | HS |
| 13 | BK x PL | 52.00 | S | 57.00 | S |
| 14 | BK x PT | 29.00 | MR | 35.00 | MR |

**Comment [T10]:** What is your base to classify genotypes as susceptible, resistant, moderately resistant and highly susceptible.

| | | | | | |
|---|---|---|---|---|---|
| 15 | BK x PS | 25.00 | R | 22.00 | R |
| 16 | BK x PSU | 14.00 | R | 17.00 | R |
| 17 | SWR x EC391087 | 79.00 | HS | 82.00 | HS |
| 18 | SWR x IC342426 | 76.00 | HS | 66.00 | HS |
| 19 | SWR x IC342464 | 74.00 | HS | 67.00 | HS |
| 20 | SWR x IC284628 | 88.00 | HS | 73.00 | HS |
| 21 | SWR x PL | 57.50 | S | 55.00 | S |
| 22 | SWR x PT | 36.50 | MR | 40.00 | MR |
| 23 | SWR x PS | 40.00 | MR | 52.00 | S |
| 24 | SWR x PSU | 31.50 | MR | 35.00 | MR |
| **ChilliParents** | | | | | |
| 25 | ByadgiDabbi | 99.50 | HS | 98.00 | HS |
| 26 | ByadgiKaddi | 99.00 | HS | 99.00 | HS |
| 27 | Shankeshwar | 97.50 | HS | 98.00 | HS |
| 28 | EC391087 | 9.00 | HR | 10.00 | HR |
| 29 | IC342426 | 15.00 | R | 19.00 | R |
| 30 | IC342464 | 22.50 | R | 27.00 | MR |
| 31 | IC284628 | 29.00 | MR | 34.00 | MR |
| 32 | Punjab Lal | 4.50 | HR | 8.00 | HR |

| | | | | | |
|---|---|---|---|---|---|
| 33 | PunjabTej | 18.50 | R | 22.00 | R |
| 34 | PunjabSindhuri | 16.00 | R | 23.00 | R |
| 35 | PunjabSurkh | 8.00 | HR | 10.00 | HR |
| 36 | Standard Check | 80.00 | HS | 71.00 | HS |

**Table 6: Categorization of chilli hybrids and their parents for resistance to leaf curl virus based on virus symptoms under natural condition and artificial inoculation**

Comment [T11]: It's better to put parent and hybrid genotypes by code number!

| Disease reaction | Natural screening | | Artificial screening | |
|---|---|---|---|---|
| | No. of genotypes | Hybrid and parents | No. of genotypes | Hybrid and parents |
| Immune | 0 | - | 0 | - |
| Highly resistant | 3 | EC 391087, Punjab Lal, PunjabSurkh | 3 | EC 391087, Punjab Lal, PunjabSurkh |
| Resistant | 8 | ByadgiDabbi x Punjab Sindhuri, ByadgiDabbi x Punjab Surkh, ByadgiKaddi x Punjab Sindhuri, ByadgiKaddi x Punjab Surkh, IC342426, IC342464, Punjab Tej, Punjab Sindhuri | 7 | ByadgiDabbi x Punjab Sindhuri, ByadgiDabbi x Punjab Surkh, ByadgiKaddi x Punjab Sindhuri, ByadgiKaddi x Punjab Surkh, IC342426, Punjab Tej, Punjab Sindhuri |
| Moderately resistant | 7 | ByadgiDabbi x Punjab Tej, ByadgiKaddi x IC342426, ByadgiKaddi x Punjab Tej, | 7 | ByadgiDabbi x Punjab Tej, ByadgiKaddi x IC342426, ByadgiKaddi x Punjab Tej, |

| | | | | |
|---|---|---|---|---|
| | | Shankeshwar x Punjab Tej, Shankeshwar x Punjab Sindhuri, Shankeshwar x Punjab Surkh, IC284628 | | Shankeshwar x Punjab Tej, Shankeshwar x Punjab Surkh, IC284628, IC342464 |
| Susceptible | 6 | ByadgiDabbi x Punjab Lal, ByadgiDabbi x EC391087, ByadgiKaddi x EC391087, ByadgiKaddi x Punjab Lal, ByadgiKaddi x IC342464, Shankeshwar x Punjab Lal | 6 | ByadgiDabbi x Punjab Lal, ByadgiDabbi x EC391087, ByadgiKaddi x EC391087, ByadgiKaddi x Punjab Lal, Shankeshwar x Punjab Lal, Shankeshwar x Punjab Sindhuri, |
| Highly susceptible | 12 | ByadgiDabbi x IC342426, ByadgiDabbi x IC342464, ByadgiDabbi x IC284628, ByadgiKaddi x IC284628, Shankeshwar x EC391087, Shankeshwar x IC342426, Shankeshwar x IC342464, Shankeshwar x IC284628, ByadgiDabbi, ByadgiKaddi, Shankeshwar, Standard Check | 13 | ByadgiDabbi x IC342426, ByadgiDabbi x IC342464, ByadgiDabbi x IC284628, ByadgiKaddi x IC284628, Shankeshwar x EC391087, Shankeshwar x IC342426, Shankeshwar x IC342464, Shankeshwar x IC284628, ByadgiDabbi, ByadgiKaddi, Shankeshwar, Standard Check, ByadgiKaddi x IC342464, |

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**Comment [T12]:** Regarding references; it's better to follow the guidelines of the journal and as much as possible you need to cite the recent references.

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