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Kavana GB
 Ph.D., Scholar, Department of
 FLA, College of Horticulture,
 Bengaluru, Karnataka, India

Seetharamu GK
 Professor and Head,
 Department of FLA, College of
 Horticulture, Bengaluru,
 Karnataka, India

Rajiv Kumar
 Principal Scientist, Division of
 Floriculture and Medicinal
 Plants, IIHR, Bengaluru,
 Karnataka, India

Satish D
 Assistant Professor,
 Department of Biotech and
 Crop Improvement, COH,
 Bagalkote, Karnataka, India

Amreen Taj
 Assistant Professor,
 Department of FLA, COH,
 Mysuru, Karnataka, India

Amruta S Bhat
 Assistant Professor,
 Department of Plant
 pathology, RHREC,
 Bengaluru, Karnataka, India

Venugopalan R
 Principal Scientist,
 Department of Statistics,
 IIHR, Bengaluru, Karnataka,
 India

Corresponding Author:
Kavana GB
 Ph.D., Scholar, Department of
 FLA, College of Horticulture,
 Bengaluru, Karnataka, India

Evaluation for disease incidence and scoring of fifty chrysanthemum genotypes (*Dendranthema grandiflora* Tzvelev) against leaf blight disease (*Alternaria alternata*) and white rust (*Puccinia horiana*) at vegetative and flowering stage

Kavana GB, Seetharamu GK, Rajiv Kumar, Satish D, Amreen Taj, Amruta S Bhat and Venugopalan R

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Abstract

During the summer and winter leaf blight and leaf rust was noticed on chrysanthemum. The disease, which was identified as caused by *Alternaria alternata* and *Puccinia horiana* respectively, which was widely spread and led to serious damage for the production sector of this crop. Therefore, a study was conducted to better understand how serious these causal organisms will cause damage. From the present investigation, results revealed that, no symptoms of leaf blight was observed in cv. HCC-1, cv. Arka Kirti and cv. Punjab Gold however, maximum disease incidence was recorded in cv. Marigold (100%) and cv. Rajat (100%) followed by the cv. N-9 (85.71%). Percent disease index at vegetative phase was maximum in cv. Rajat (44.28%), percent disease index was zero for the cv. HCC-1, HYDC-7, Arka Kirti and Punjab Gold. Percent disease index at flowering stage was maximum in the cv. Arka Chandrika (94.28%) and it was minimum in cv. Arka Kirti (5.71%). Lowest disease incidence for leaf rust was recorded by the cv. HCC-1 (14.28%) whereas cv. Marigold recorded the highest disease incidence (100%) followed by cv. White Star (85.71%) and cv. Corcum Small (85.71%). Lowest Percent disease index was recorded by the cv. Arka Kirti (11.42%) during vegetative phase whereas highest was recorded by the cv. Marigold (60.00%). During flowering phase lowest Percent disease index was recorded by the cv. Arka Kirti (28.57%), whereas it was maximum in cv. Marigold (97.14%).

Keywords: Chrysanthemum, leaf blight, leaf rust, genotypes, disease, scoring

Introduction

India, the land with many landscapes, here we find the green mountains as well as the blue seas and the yellow sandy deserts so, the flower variety of this country ranges from one state to another due to the soil quality. Whenever we think about sending flowers to someone, it's always the usual roses or orchids which are great gifting options for sure but, there are flowers that grow in India and used for different purposes from time to time. Floriculture is increasingly regarded as a viable diversification from the traditional field crops and other horticultural crops due to increased returns per unit and the increasing habit of saying it with flowers during all occasions. Flowers are symbol of beauty, love and tranquillity, they form the soul of the garden and convey the message of nature. Besides their aesthetic and religious value, flowers are also important for their economic use (Siddiqua *et al.*, 2018) [12]. One such flower, out valuing all utilities of the world through its magnificent beauty, varying hues and colors is the golden flower 'chrysanthemum'.

Chrysanthemum (*Dendranthema grandiflora* Tzvelev.) is one of the most beautiful flowering plant referred as "Queen of the East" and also known as "Autumn flower" belongs to family Asteraceae. Chrysanthemum is cultivated as a traditional flower crop. The major uses of chrysanthemum are making garlands, veni, bracelets, flower decoration, garden display and for religious offerings.

In the recent years, it is preferred particularly for pot cultures, cut flowers and loose flowers and also for bedding purposes due to the wide range of diversity in the flower shape, size of flowers, brilliant colour tones, long lasting flower life, diversity in height and growth habit has increased its versatility of use (Vetrivel and Jawaharlal., 2014) [15].

Due to the frequent changing in climate with an increasing atmospheric humidity and temperature, many plant diseases

can attack chrysanthemum, mostly fungal diseases which cause considerable losses in productivity and quality as well as the aesthetic value. These diseases may include leaf blight caused by *A. alternata*, leaf spot caused by *Nigrospora oryzae*, the most devastating disease leaf rust by *Puccinia horiana verticillium* wilt by *Verticillium dahlia* and the powdery mildew caused by *Golovinomyces sp.*, (Vetrivel and Jawaharlal., 2014) [15].

Table 1: Screening of leaf blight and leaf rust in different chrysanthemum genotypes

Sl. No.	Genotypes	Leaf blight			Leaf rust		
		Disease incidence (%)	PDI I (%)	PDI II (%)	Disease incidence (%)	PDI I (%)	PDI II (%)
1.	Sapna	42.85	22.85	65.71	57.14	54.28	82.85
2.	Arka Chandrika	57.14	25.71	94.28	71.42	34.28	80.00
3.	Red Gold	42.85	28.57	62.85	42.85	40.00	77.14
4.	White Star	71.42	14.28	54.28	85.71	42.85	85.71
5.	Aishwarya-1	14.28	28.57	54.28	28.57	48.57	77.14
6.	HCC-1	0.00	0.00	14.28	14.28	34.28	51.42
7.	N-9	85.71	34.28	51.42	42.85	57.14	85.71
8.	NBRI Little Pink	71.42	31.42	48.57	57.14	34.28	60.00
9.	HYDC-7	28.57	0.00	11.42	42.85	40.00	65.71
10.	Hossur	71.42	8.57	17.14	28.57	34.28	68.57
11.	Winter Queen	42.85	11.42	20.00	57.14	31.42	60.00
12.	Ruby Red	28.57	2.85	11.42	71.42	28.57	71.42
13.	Scent White	57.14	2.85	8.57	57.14	25.71	54.28
14.	Haldigatti	28.57	5.71	14.28	42.85	37.14	57.14
15.	Aparajitha	14.28	11.42	17.14	57.14	42.85	60.00
16.	Lalima	28.57	22.85	28.57	42.85	37.14	62.85
17.	Rajat	100.00	44.28	48.57	71.42	40.00	51.42
18.	Scent Yellow	42.85	5.71	14.28	42.85	34.28	48.57
19.	Poomima White	71.42	8.57	17.14	28.57	31.42	40.00
20.	Marigold	100.00	20.00	25.71	100.00	60.00	97.14
21.	Poomima Yellow	71.42	11.42	17.14	14.28	54.28	82.85
22.	Ratilam Selection	42.85	5.71	17.14	42.85	51.42	68.57
23.	Dalore	57.14	11.42	20.00	42.85	37.14	54.28
24.	Dolley Orange	42.85	14.28	22.85	57.14	40.00	51.42
25.	Yellow Anemone	71.42	8.57	17.14	28.57	34.28	54.28
26.	NBRI Little Orange	42.85	11.42	17.14	71.42	31.42	48.57
27.	Corcum Small	85.71	5.71	14.28	85.71	28.57	60.00
28.	Karnool Yellow	42.85	5.71	14.28	57.14	37.14	48.57
29.	Thanu White	42.85	11.42	20.00	71.42	34.28	57.14
30.	IIHR RC-1	85.71	5.71	14.28	57.14	31.42	60.00
31.	Arka Kirti	0.00	0.00	5.71	14.28	11.42	28.57
32.	Punjab Gold	0.00	0.00	8.57	14.28	37.14	48.57
33.	Arka Pink Star	42.85	8.57	11.42	28.57	34.28	54.28
34.	Vijay Kiran	71.42	14.28	17.14	28.57	31.42	62.85
35.	Agnipath	42.85	22.85	31.42	42.85	25.71	42.85
36.	Yellow Delight	57.14	22.85	37.14	71.42	22.85	51.42
37.	Kaveri Orange	28.57	5.71	14.28	28.57	25.71	45.71
38.	Bidhan Mum	42.85	14.28	22.85	57.14	28.57	60.00
39.	Mallika Yellow	71.42	34.28	45.71	42.85	37.14	54.28
40.	Co-1	28.57	11.42	17.14	71.42	42.85	65.71
41.	B47/101	28.57	14.28	25.71	71.42	48.57	74.28
42.	Airth-2	42.85	17.14	22.85	57.14	34.28	60.00
43.	Jyostia	28.57	11.42	20.00	57.14	28.57	48.57
44.	C6-11	28.57	5.71	11.42	42.85	25.71	54.28
45.	Kalpana	42.85	20.00	25.71	71.42	34.28	51.42
46.	Yellow Spoon	42.85	25.71	28.57	28.57	42.85	60.00
47.	Yellow Gold	28.57	31.42	42.85	57.14	28.57	80.00
48.	Thanu Yellow	28.57	14.28	20.00	42.85	31.42	77.14
49.	Kaveri Pink	14.28	5.71	20.00	28.57	40.00	45.71
50.	Cream White	42.85	8.57	14.28	28.57	25.71	51.42

PDI: Percent disease index

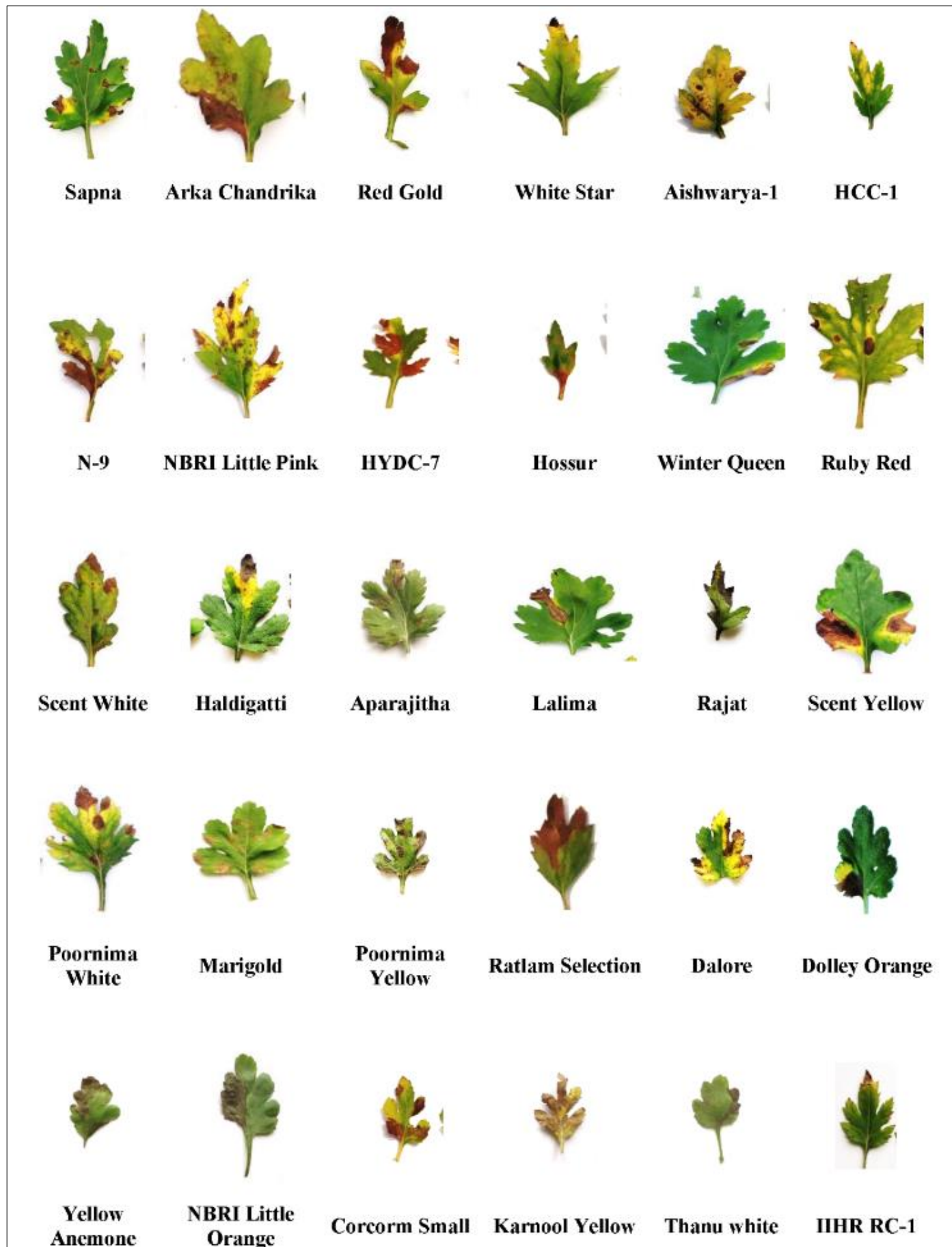


Fig 1: Leaf blight scoring in different chrysanthemum genotypes

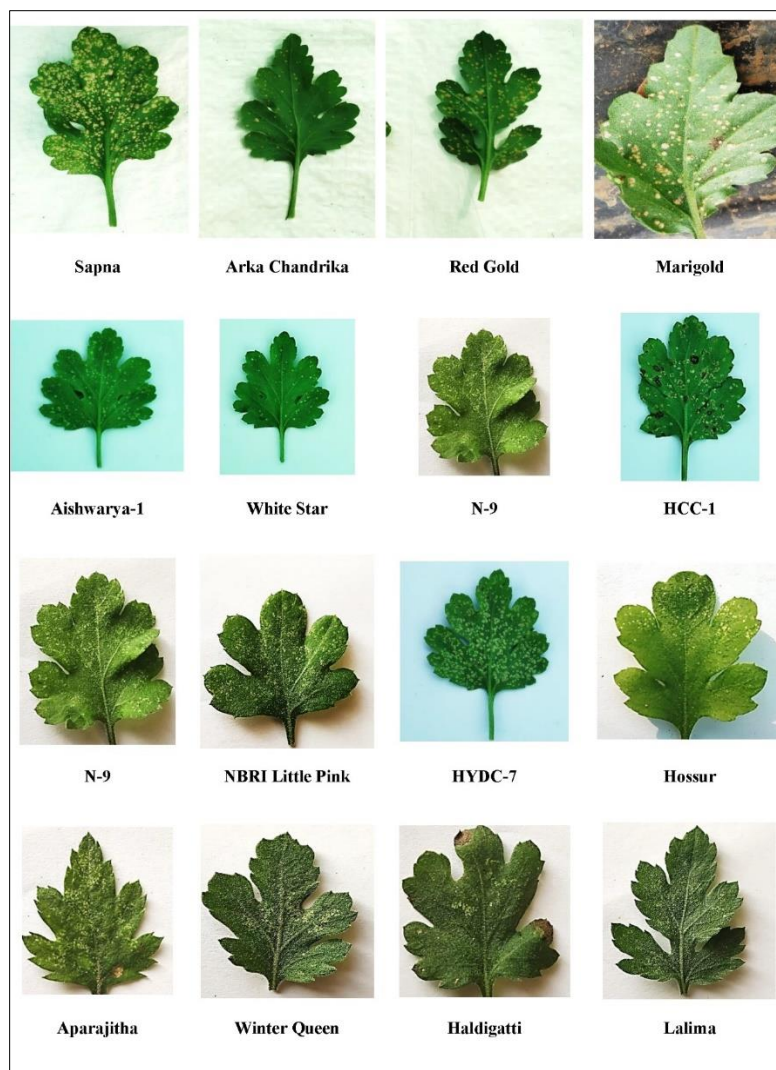
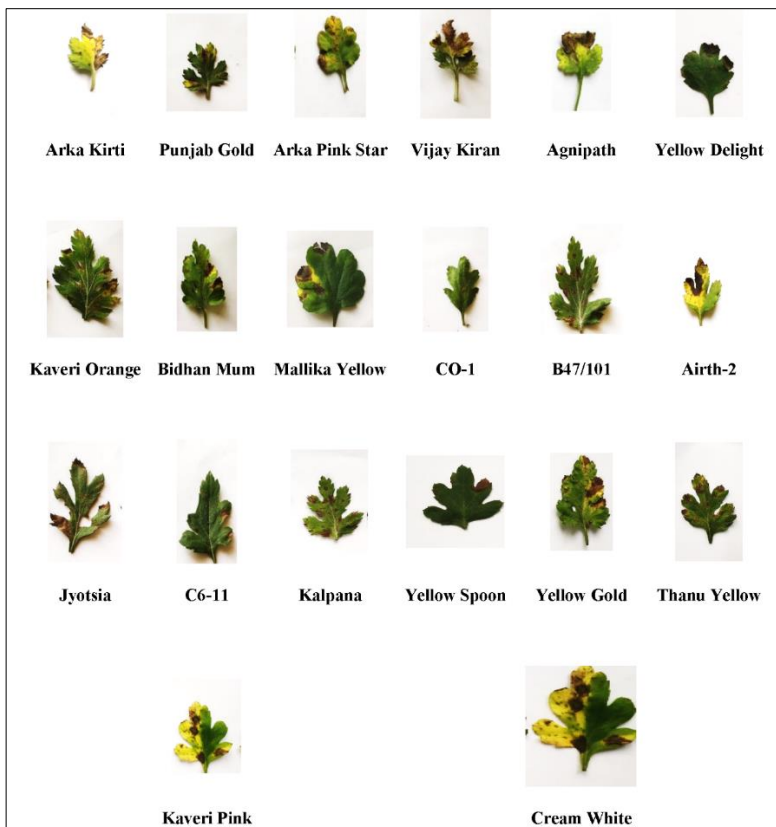
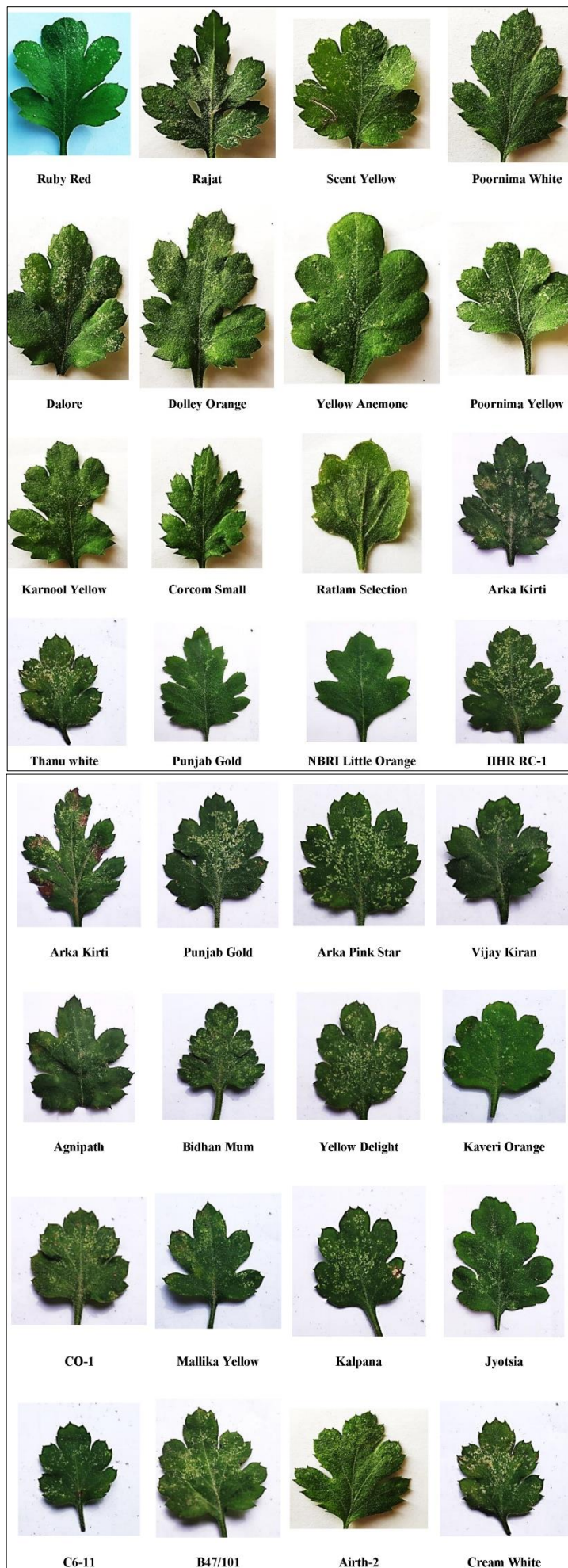


Fig 2: Leaf rust scoring in different chrysanthemum genotypes





Leaf blight disease caused by *Alternaria alternata* poses significant challenges to chrysanthemum cultivation. This fungal pathogen primarily targets mature leaves, swiftly spreading through plant tissues, soil, and the surrounding air, particularly in high-temperature conditions. *A. alternata* exacerbates the damage by secreting fungal toxins and enzymes that degrade cell walls in chrysanthemum tissues (Kumar *et al.*, 2011) [6]. This results in the formation of round spots with dark mildew layers as the pathogen obtains nutrients from decaying tissue.

The impact of *A. alternata* on chrysanthemum crops is severe, leading to yield losses exceeding 80% and adversely affecting flower quality. Additionally, *A. alternata* is a ubiquitous fungus known to be pathogenic in various important crop plants and can also act as an endophyte in many plant species. Consequently, effective management strategies are essential to mitigate the detrimental effects of leaf blight disease caused by *A. alternata* on chrysanthemum cultivation. To study all these the present investigation was conducted (Kumar *et al.*, 2011) [6].

Materials and Methods

The experiment was conducted to study leaf blight and leaf rust scoring of chrysanthemum (*Dendranthema grandiflora* Twelve) genotypes during vegetative (PDI -I) and flowering stage (PDI-II) traits during the year 2023. The experiment comprised of fifty chrysanthemum genotypes such as., Sapna, Arka Chandrika, Red Gold, White Star, Aishwarya-1, HCC-1, N-9, NBRI Little Pink, HYDC-7, Hossur, Winter Queen, Ruby Red, Scent White, Haldigatti, Aparajitha, Lalima, Rajat, Scent Yellow, Poornima White, Marigold, Poornima Yellow, Ratlam Selection, Dalore, Dolley Orange, Yellow Anemone, NBRI Little Orange, Corcum Small, Karnool Yellow, Thanu White, IIHR RC-1, Arka Kirti, Punjab Gold, Arka Pink Star, Vijay Kiran, Agnipath, Yellow Delight, Kaveri Orange, Bidhan Mum, Mallika Yellow, Co-1, B47/101, Airth-2, Jyostia, C6-11, Kalpana, Yellow Spoon, Yellow Gold, Thanu Yellow, Kaveri Pink and Cream White.

The genotypes were evaluated in Randomized Complete Block Design with two replications at College of Horticulture, Bengaluru. The plants were planted at a spacing of 60 X 45 cm and all the recommended cultural practices were followed. Five competitive plants were tagged at random in each treatment in each replication for recording detailed observation and the data were recorded for disease incidence, Percent Disease Index I (Vegetative stage) and II (Flowering stage).

Leaf blight screening

a) The plants were examined randomly and scored for disease severity (*Chrysanthemum blight*) (Figure 1) by following 0-5 scale (Kumar *et al.*, 2011) [6]. The details of scales are as shown below.

1. No disease symptoms
2. A few spots towards tip covering 10% leaf area
3. Several dark brown patches covering up to 20% leaf area
4. Several patches with paler outer zone covering up to 40% leaf area
5. Leaf blight covering up to 75% leaf area or breaking of the leaves from center
6. Complete drying of the leaves or breaking of the leaves from center

Rust disease screening

The observations on disease severity were recorded (Figure 2). Each genotype were scored by using the disease scale for chrysanthemum rust. A disease rating scale given by Bonde *et al.* (1995) was used where.

1. no infection
2. Fewer than five pustules per plant
3. 5 to 100 pustules per plant
4. More than 100 pustules
5. More than 100 pustules per plant and two or more leaves with coalesced over at least 75 Percent of the leaf area

For both leaf blight and leaf rust disease incidence and percent disease index was calculated and expressed in percentage using the formula,

$$\text{Disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

Percent disease index

Each plant was visually assessed for percent leaf area infected, using linear 0-5 scale and the Percent Disease Index (PDI) was calculated (McKinney, 1923) [8] and expressed in percentage

$$\text{Percent disease index} = \frac{\text{Sum of rating values}}{\text{Number of leaves graded} \times \text{Maximum rating}} \times 100$$

Results and Discussion

Leaf blight in chrysanthemum

Various biotic diseases are threatening the cultivation and good quality bloom yield of chrysanthemum. Among them,

major diseases are, leaf blight caused by *Alternaria alternata* (Fries.) Keissler and leaf rust are the most destructive disease. The plants will be examined randomly and scored for disease severity for that disease incidence and Percent disease index was calculated and it is presented in the Table 1. Among the genotypes studied for leaf blight, no symptoms of leaf blight in cv. HCC-1, cv. Arka Kirti and cv. Punjab Gold while maximum disease incidence was recorded in the cv. Marigold (100%) and cv. Rajat (100%) followed by cv. N-9 (85.71%). Percent disease index at vegetative phase was maximum in the cv. Rajat (44.28%) followed by cv. N-9 (34.28%) and cv. Mallika Yellow (34.28%) and no percent disease index for the cv. HCC-1, HYDC-7, Arka Kirti and Punjab Gold. Percent disease index at flowering phase was maximum in the cv. Arka Chandrika (94.28%) followed by cv. Sapna (65.71%) and minimum was recorded by the cv. Arka Kirti (5.71%).

Leaf rust in chrysanthemum

Among the chrysanthemum genotypes studied (Table 1), lowest disease incidence was recorded in the cv. HCC-1 (14.28%) whereas cv. Marigold recorded the highest disease incidence (100%) followed by cv. White Star (85.71%) and cv. Corcum Small (85.71%). Lowest Percent disease index was recorded in cv. Arka Kirti (11.42%) during vegetative phase, whereas highest was recorded in cv. Marigold (60%) which was followed by cv. N-9 (57.14%). During flowering phase lowest Percent disease index was recorded by the cv. Arka Kirti (28.57%) whereas it was maximum in cv. Marigold (97.14%) followed by N-9 (85.71%).

Discussion

Various biotic diseases are threatening the cultivation and good quality bloom yield of chrysanthemum. Among them, major diseases are, leaf blight caused by *Alternaria alternata* (Fries.) Keissler and leaf rust are the most destructive disease, commonly prevailing in almost all chrysanthemum growing areas and consequently causing accountable quantitative losses (> 80% yield losses) as well as deteriorating the quality of produce earlier reported by Arunkumar *et al.* (2011)^[1] and Divyajyothi *et al.* (2018)^[4] in chrysanthemum.

No symptoms of leaf blight in the cv. HCC-1, cv. Arka Kirti and cv. Punjab Gold while maximum disease incidence was recorded in the cv. Marigold (100%) and cv. Rajat (100%) followed by the cv. N-9 (85.71%). Percent disease index at vegetative phase was maximum in the cv. Rajat (44.28%) followed by cv. N-9 (34.28%) and cv. Mallika Yellow (34.28%) and no percent disease index for the cv. HCC-1, HYDC-7, Arka Kirti and Punjab Gold. Percent disease index at flowering phase was maximum in the cv. Arka Chandrika (94.28%) followed by cv. Sapna (65.71%) and minimum was recorded by the cv. Arka Kirti (5.71%). These results of the present study were in consonance with the earlier findings of those workers who reported varietal screening for *Alternaria spp.* Bedi and Singh, (1972)^[2]; Minuto *et al.* (1997)^[9]; Sen and Pathania, (1997)^[11] and Kopacki and Wagner, (2003)^[5] in chrysanthemum.

Among the chrysanthemum genotypes studied, lowest disease incidence for leaf rust was recorded by the cv. HCC-1 (14.28%) whereas cv. Marigold (100%) recorded the highest disease incidence followed by cv. White Star (85.71%) and cv. Corcum Small (85.71%). Lowest percent disease index was recorded by the cv. Arka Kirti (11.42%)

during vegetative phase whereas highest was recorded by the cv. Marigold (60.00%) which was followed by cv. N-9 (57.14%). During flowering phase lowest percent disease index was recorded by the cv. Arka Kirti (28.57%) whereas maximum was recorded by the cv. Marigold (97.14%) followed by N-9 (85.71%). The high frequency of resistance to white rust indicated that the resistance, reported to be controlled by a single dominant gene, might have been stably inherited by the next generation similar results are obtained in chrysanthemum by Sriram *et al.* (2015)^[14]. Therefore, these genetic resources are expected to be helpful for cross breeding programs to breed new genotypes resistant to white rust disease in chrysanthemum.

The use of white rust resistant genotypes will be useful for breeding programs in developing varieties with novel flower quality coupled with resistant to white rust for safe cultivation of chrysanthemum. *Puccinia horiana* is the causal agent of chrysanthemum white rust. This microcyclic autoecious rust has a quarantine status and cause major damage in the commercial production of *Dendranthema grandiflora* by Kumar *et al.* (2021)^[7] in chrysanthemum. Higher temperature and relative humidity prevailing in protected conditions further aggravation disease incidence and severity reported by Snehatharani *et al.* (2022)^[13] in chrysanthemum. Rainfall and temperature coupled with edaphic or site-specific factors were reported as risk factors in case of leaf blight reported by Pethybridge *et al.* (2009)^[10] in Pyrethrum.

Conclusion

No symptoms of leaf blight was observed in cv. HCC-1, cv. Arka Kirti and cv. Punjab Gold however, maximum disease incidence was recorded in cv. Marigold (100%) and cv. Rajat (100%) followed by the cv. N-9 (85.71%). Percent disease index at vegetative phase was maximum in cv. Rajat (44.28%), percent disease index was zero for the cv. HCC-1, HYDC-7, Arka Kirti and Punjab Gold. Percent disease index at flowering stage was maximum in the cv. Arka Chandrika (94.28%) and it was minimum in cv. Arka Kirti (5.71%).

Lowest disease incidence for leaf rust was recorded by the cv. HCC-1 (14.28%) whereas cv. Marigold recorded the highest disease incidence (100%) followed by cv. White Star (85.71%) and cv. Corcum Small (85.71%). Lowest Percent disease index was recorded by the cv. Arka Kirti (11.42%) during vegetative phase whereas highest was recorded by the cv. Marigold (60.00%). During flowering phase lowest Percent disease index was recorded by the cv. Arka Kirti (28.57%), whereas it was maximum in cv. Marigold (97.14%).

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