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IMPACT OF DOWNY MILDEW DISEASE CAUSED BY *PSEUDOPERONOSPORA CUBENSIS* ON CUCUMBER GERMPLASM AND ITS HORTICULTURAL ATTRIBUTES

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A B S T R A C T

Downy mildew caused by *Pseudoperonospora cubensis* is one of the most destructive diseases of cucumber (*Cucumis sativus* L.). This disease mainly affects foliage. Growth parameters like plant weight, fresh weight of shoot and root, dry weight of shoot and root, plant height, shoot and root length and total yield are helpful to assess resistance level. The objective of current study was the identification of new sources of resistance by screening of available cucumber germplasm against downy mildew disease and its impact on horticultural attributes. A total of 10 varieties was tested employing Randomized Complete Block Design (RCBD) in the research area of Department of Plant Pathology, University of Agriculture, Faisalabad. Results from the study showed that minimum disease incidence of 18.26%with disease rating 3 in variety Hilton and maximum incidence of 51.90 with disease rating 7 was observed in Cucumber-363. HCU-163, Panda India, Anmol, Captan and Local with disease rating 6 were moderately susceptible with varying level of disease incidence. Anmol variety showed highest fresh weight of roots (2.63g), No. of leaves (30 per plant), plant yield (485.60g) and plant weight (15.86g). Panda India and Captan expressed highest dry weight of roots (0.17g) and root length (0.18m). Highest fresh (13.76g) and dry weight of shoots (8.60g), Shoot length (3.15m) and plant height (3.23m) were expressed by Nakrsan and Cucumber-363. So it is concluded that Anmol variety has good horticultural attributes that could be used in developing improved cultivar.

Keywords: Cucumber, Downy mildew ,Growth parameters, Germplasm.

INTRODUCTION

Cucumber (*Cucumis sativus L.*) Belonging to family cucurbitaceae is fourth most widely grown vegetable crop in world afte tomato, cabbage and onion (Tatlioglu,1993) and world's second largest cultivated food crop of the cucurbits after watermelon (Heywood *et al.*, 2007; Judd *et al.,* 2008). The word cucumber was derived from the Dutch word 'Komkommer'. The origin of cucumber was Himalaya in Northern India (Molen, 2007) where it has been grown for more than 3000 years and around 2000B.C. From India, it was brought to the area around the Mediterranean Sea and Egypt .China ranks at 1st position in cucumber production followed by Turkey, Iran, Russia and USA (USDA Economic Research Service, 2007). Pakistan ranks 50th positions among worlds cucumber producing countries grown on 3.37 thousand hectares with production of 68.67 tones (Anonymous, 2018). Cucumber is considered as important crop as its flesh contains 96% water and also has substantial amount of potassium, phosphorus, copper and magnesium. It is also a rich source of calcium (14%), iron (0.2%), vitamin B (3%), C (4%), K (19%) and consumed as common salad ingredient (Herbst, 2001). It is widely grown all over the world and is

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attacked by different fungal, bacterial and viral diseases. Among fungal diseases, Downy mildew disease is a potential threat to cucumber (Thomas, 1996; Dick, 2001) which reduces yield from 10-40% which may lead up to 100% under favorable environmental conditions (Colucci *et al*., 2006: Ashfaq *et al.*2014).

Chlorosis, necrosis, stunting, curling and death of whole plant are characteristic symptoms of downy mildew disease (Colucci and Holmes, 2010). Pale green angular spots give mottled appearance to the dorsal side of leaves. While on ventral side of leaves light purple mycelium of lemon shaped bearing sporangia are produced (Hashmi, 1994).

Abiotic factors like temperature, humidity and wind speed affect the crop quality and productivity. The temperature ranges for *P.cubensis* is 5-30° C and maximum growth occur at 15ºC. Warm and humid weather favors the disease development. Maximum disease development occurs at low 5-28% relative humidity (Cohen *et al*., 1971). Downy mildew has direct effect on foliage as it reduces the photosynthetic activity in early plant development stages. Reduction in photosynthetic activity is responsible for stunted growth in plants and premature defoliation of fruits (Colucci and Holmes, 2010). It deteriorates the quality and quantity of yield by reducing soil microbial activity (Said *et al.,* 2014). Generally natural compounds and organic fertilizers are successfully applied for enhancing natural resistance in plants against different diseases and pests (Scheuerell and Mahaffee, 2006). These compounds act as plant growth stimulant or soil conditioner which increase yield by improving plant growth, regulating hormone level and enhancing stress tolerance (Piccolo *et al.,* 1992).

When the cucumber plants are infected by downy mildew disease, a decrease in growth parameters of plant like plant length, total yield per plant, fresh and dry weight of the plant are observed. Management of this disease resulted in better development of foliage of crop which led to more number of fruits per plant, longer and heavier fruit with higher yield. Although, chemical synthetic fungicides succeed to manage several plant diseases, they increase production costs, incidence of health problems and pollution of environment. So, there is dire need to find alternatives of fungicide which must be cost effective and ecofriendly. Horticultural parameters play an important role for the selection of resistance varieties against disease. Resistant varieties can be selected on the basis of data regarding growth parameters like plant weight, fresh weight of shoot and root, dry weight of shoot and root, plant height, shoot and root length and total yield. Through breeding programme, we can develop resistant varieties but it is time consuming method. There is an alternative of this long term process that is screening of available germplasm to identify the source of resistance with good horticultural parameters. So, the present study was planned to find out the resistant variety with good horticultural attributes by screening of cucumber germplasm against downy mildew disease and its impact on horticultural attributes.

METHODOLOGY

Establishment of Disease Screening Nursery: Ten cultivars/lines (Hcu-163A, Sancanto, Hilton, Captan, Local, Anmol, Kargil, Nakrsan, Panda India and Cucumber-363) were taken from the Vegetable Research Institute (VRI), Ayub Agricultural research institute, Faisalabad (AARI). Screening nursery of cucumber plants were established in field area, Department of Plant Pathology, University of Agriculture, Faisalabad. Seedlings were planted with three replications with R×R distance 100cm and P×P distance 60cm. All the cultural practices were done for establishment of nursery. Disease incidence data was recorded according to disease rating scale given by Jenkins and Wehner (1983). According to scale, 0= No disease symptom (Immune), 1-3= Resistant, 3-4=moderately resistant, 4-6= Moderatly susceptible, 6-7= Susceptible and 7-9= highly susceptible.

Observation record: Downy mildew affects the plant at all growth stages but only foliage is affected, reduction in photosynthetic activity results in yield loss and stunted plant growth. Data regarding plant height and weight, fresh weight of shoot and root, dry weight of shoot and root, shoot and root length and total yield were recorded. Three plants were selected randomly and their height, shoot and root length were measured with the help of meter rod (Seco HI 2-Meter GNSS Pocket Rod) and then average was calculated. Leaves were counted manually from the three plants which were selected randomly from each replication and then average was calculated. For weighing dry weight, roots and shoots were exposed to the sunlight for 24 hrs, then these were placed in oven for oven drying at 72˚C for 28 hrs and dry weight was calculated. Plant weight, fresh weight of shoots and roots were calculated on weighing balance

(Sartorius Company TH-600). Fully ripened cucumbers were plucked from each plant and then weight was measured on weighing balance.

STATISTICAL ANALYSIS

Data obtained from field trials parameters was subjected to randomize complete block design (RCBD) as described by Steel *et al.*, 1997. To determine the significant differences, least significant difference (LSD) design was applied. All the statistical tests were performed by using SAS/STAT statistical software (SAS Institute, 1990).

RESULTS

Out of 10 varieties/lines, one variety (Hilton) expressed resistance response with 18.26% disease incidence and disease rating of 3. While five moderately susceptible varieties i.e. HCU-163A, Panda India, Anmol, Captan and Local showed 31.73, 32.90, 33.83, 34.60, 38.70% disease incidence with disease rating of 6. Similarly, four varieties (Sancanto, Nakrsan, Kargil and Cucumber- 363) expressed susceptible response and 44.76, 45.70, 46.70, 51.90 % disease incidence with disease rating of 7 (Table 1).

Table 1. Response of cucumber varieties/lines against Downy Mildew Disease under Field conditions

Sr. #	Varieties/lines	Disease Incidence %	Disease Rating	Response
1	Hilton	18.26j	3	R
2	HCU-163A	31.73i	6	MS
3	Panda India	32.90h	6	MS
4	Anmol	33.83g	6	MS
5	Captan	34.60f	6	MS
6	Local	38.70e	6	MS
7	Sancanto	44.76d	7	S
8	Nakrsan	45.70c	7	S
9	Kargil	46.70b	7	S
10	Cucumber-363	51.90a	7	S
	LSD		0.29	

*Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test (P ≤ 0.05).
R = Resistant MS = Moderately susceptible S = Susceptible

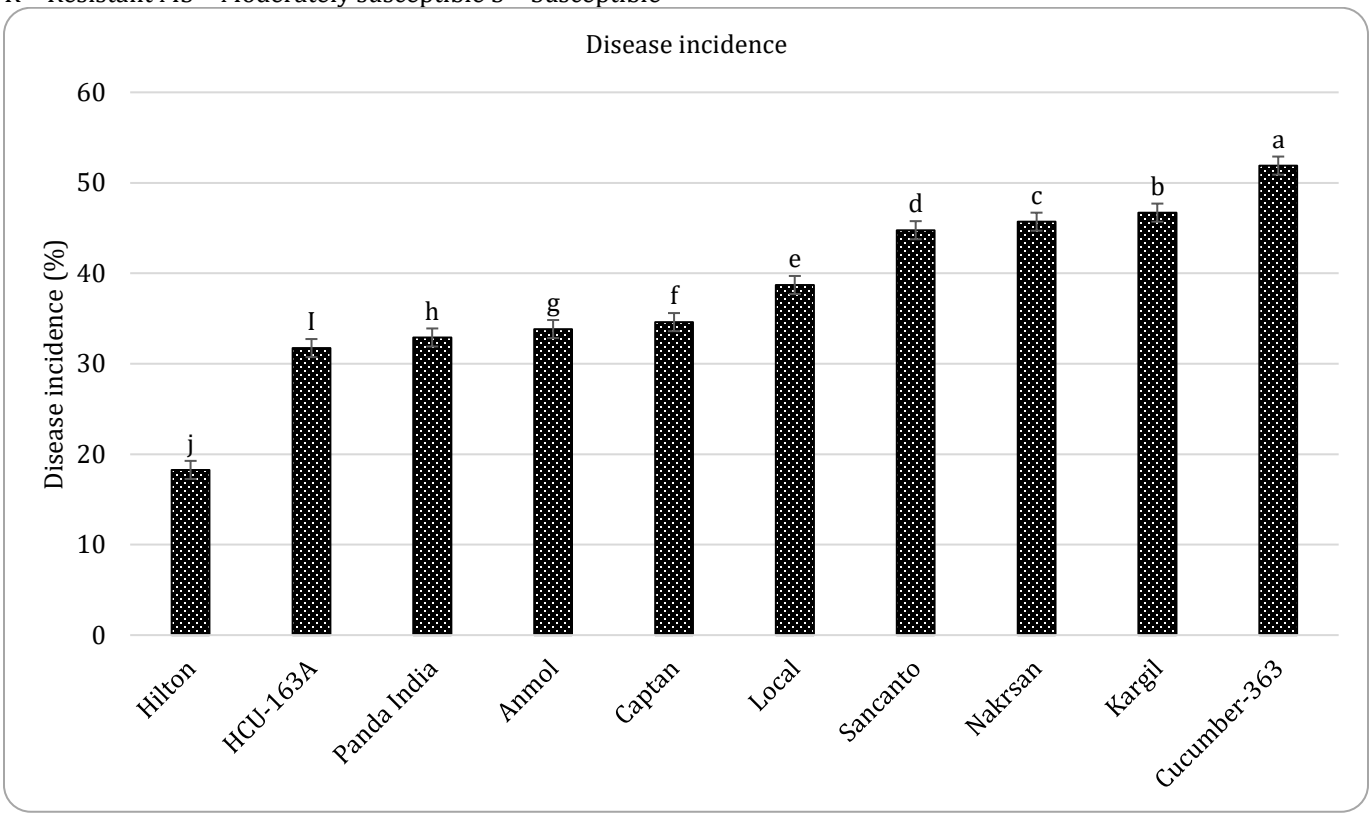

Figure 1. Disease incidence on various genotypes of cucumber.

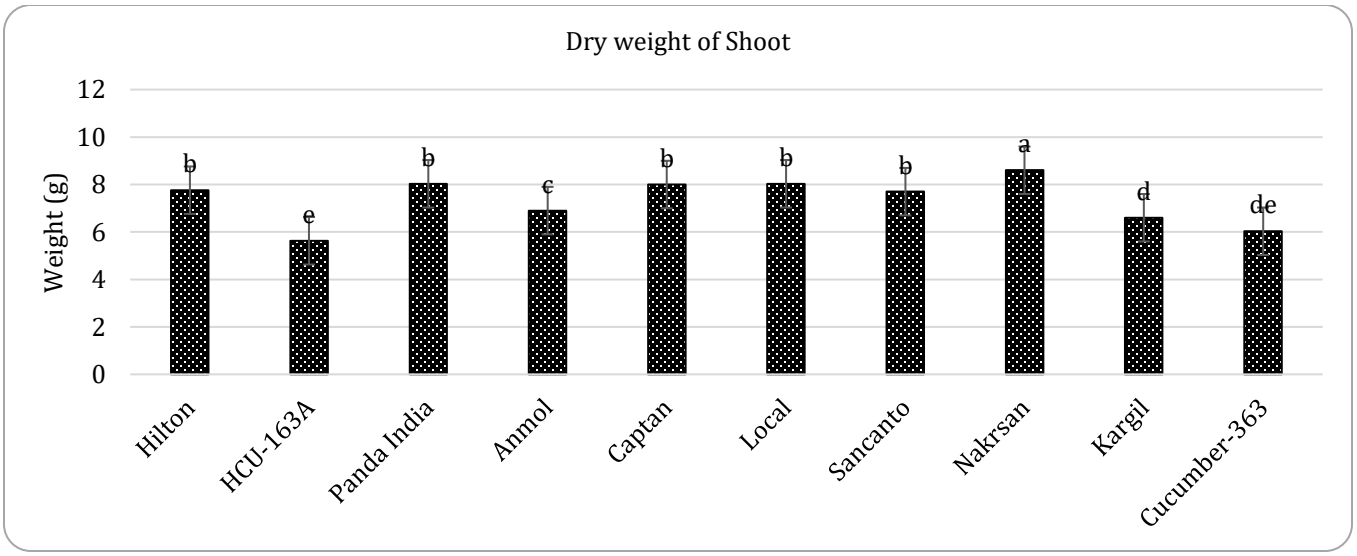

Figure 2. Dry weight of shoot of various genotypes.

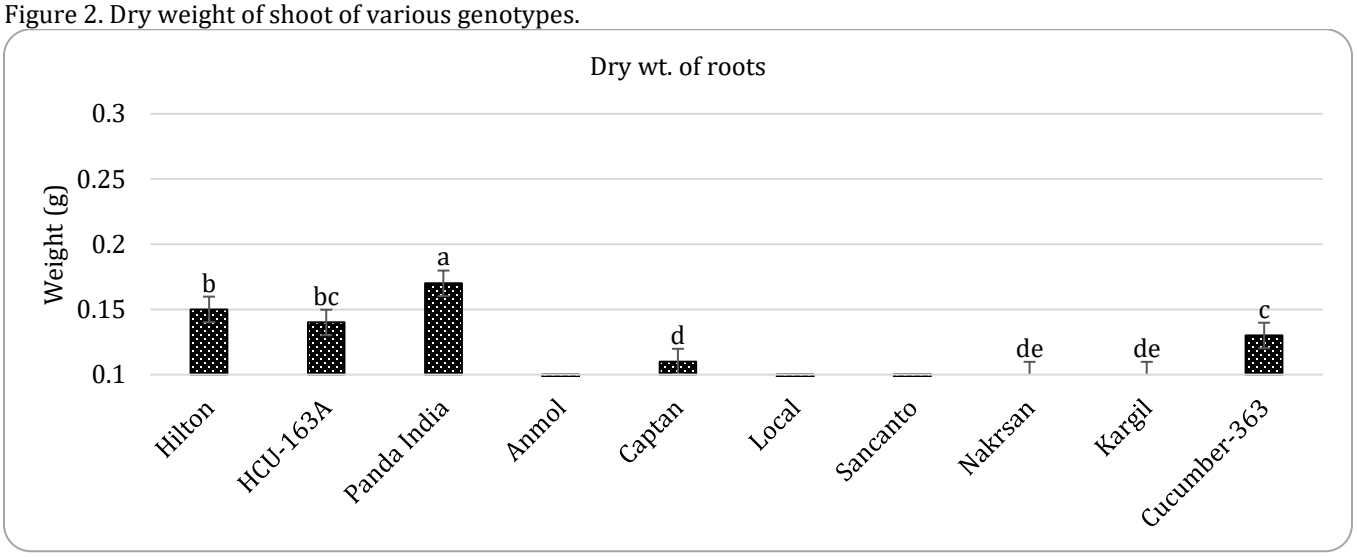

Figure 3. *Dry* weight of root of various genotypes.

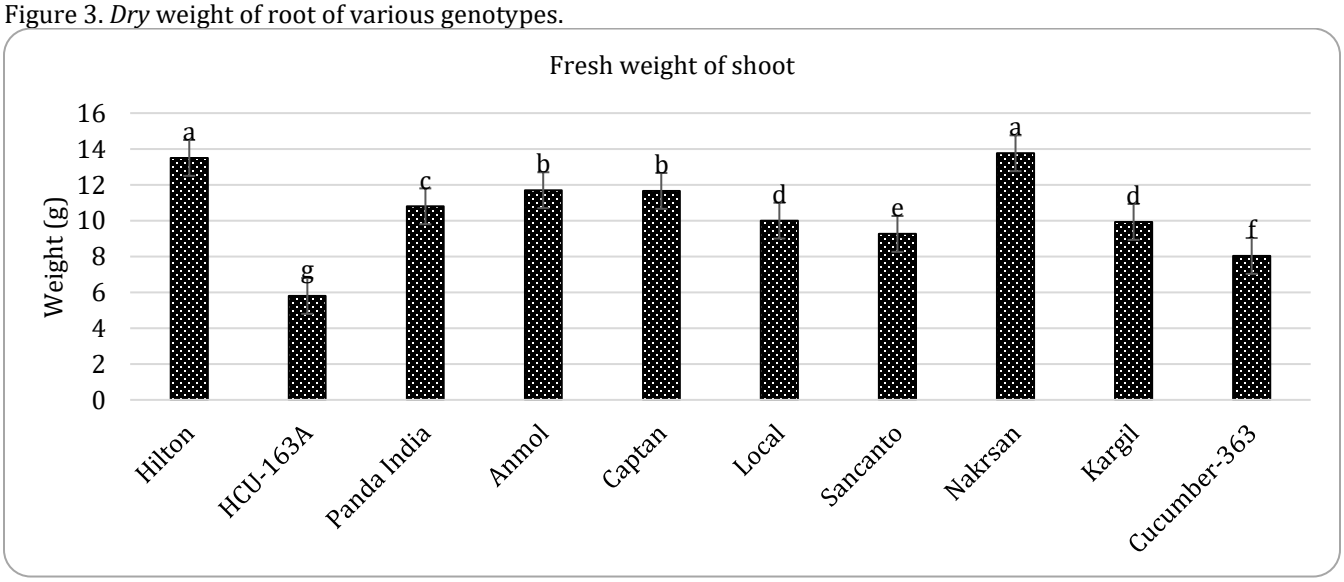

Figure 4. *Fresh* weight of root of various genotypes.

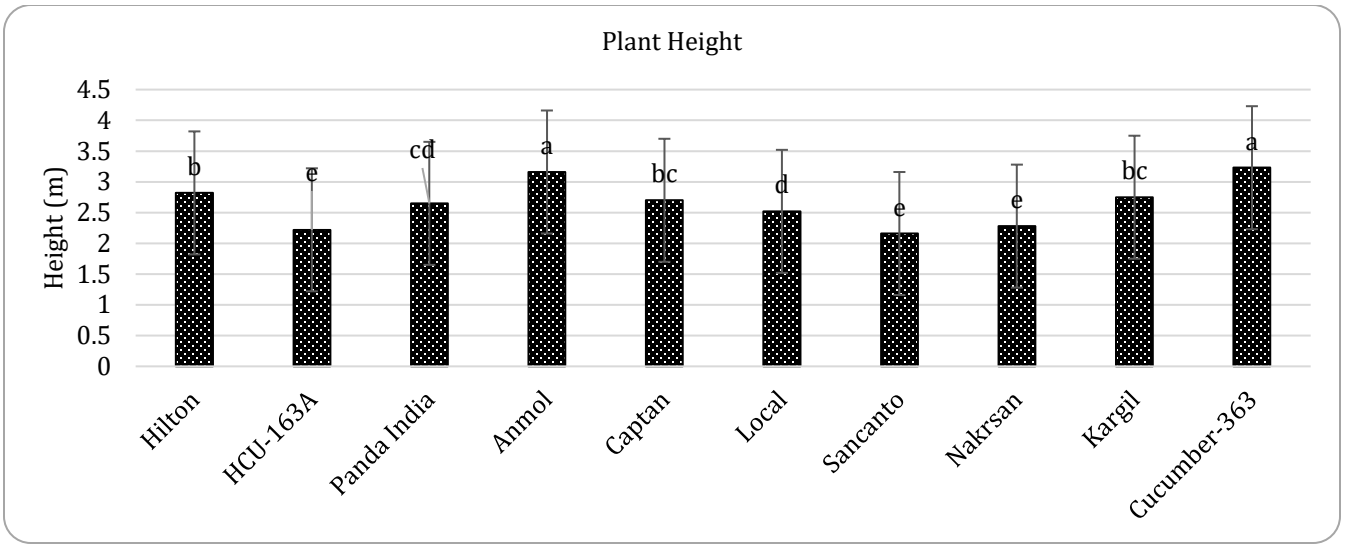

Figure 5. *Plant height* of root of various genotypes.

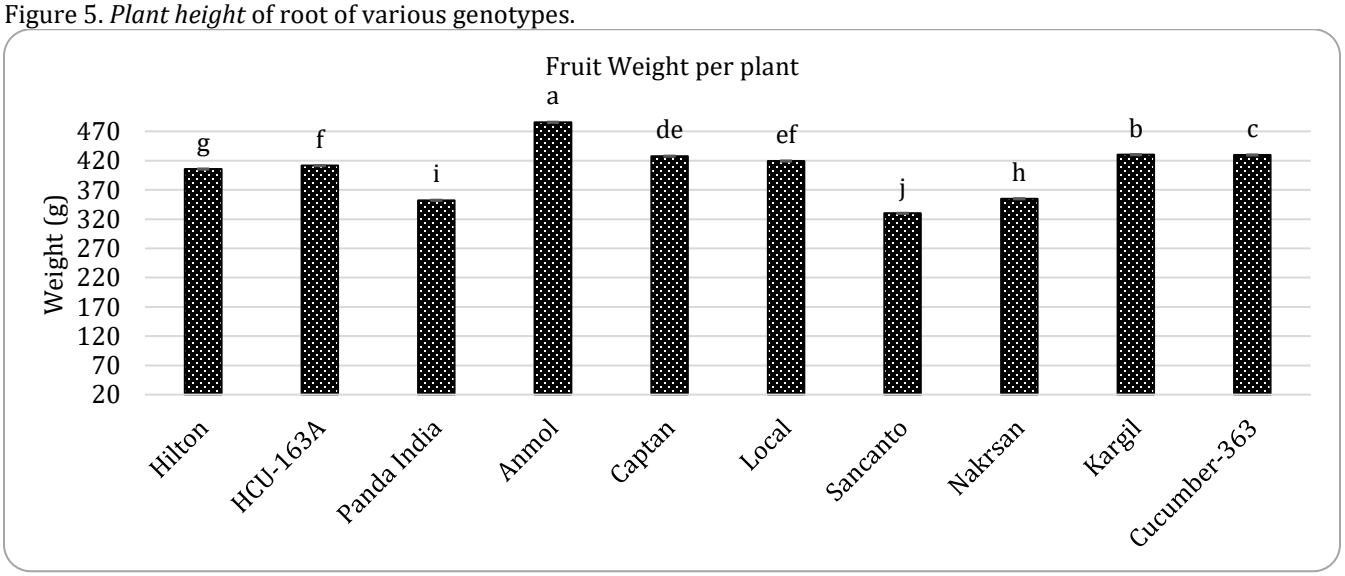

Figure 6. *Fruit* weight on various cultivars

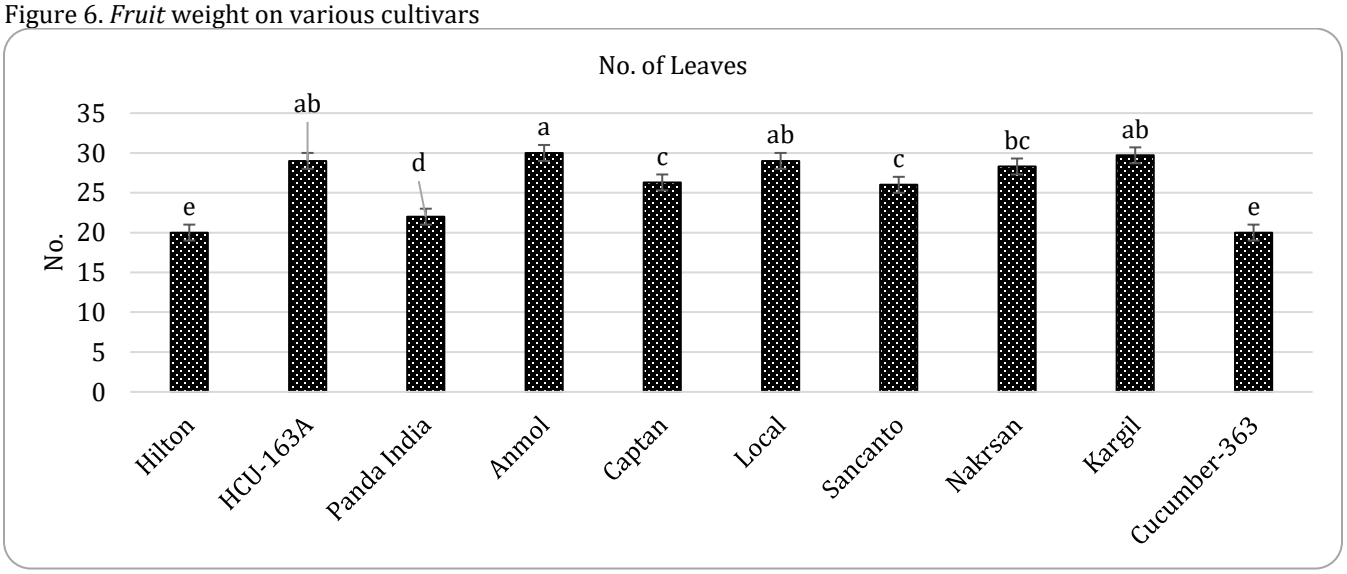

Figure 7. *Fruit* weight on various cultivars

Table 2. Impact of Downy mildew disease on horticultural parameters of cucumber

Varieties/lines	Disease Incidence %	DWR(g)	DWS(g)	FWS (g)	FWR (g)	Plant Height (m)	No. of Leaves	RL(m)	SL (m)	Plant Weight (g)	Fruit Wt. per plant (g)	Response
Hilton	18.26j	0.15b	7.76b	13.50a	2.20abcd	2.82b	20.00e	0.09a	2.73bc	15.60a	405.60g	R
HCU-163A	31.73i	0.14bc	5.63e	5.80g	1.96cd	2.22e	29.00ab	0.09a	2.23e	8.00f	411.40f	MS
Panda India	32.90h	0.17a	8.03b	10.80c	1.73d	2.65cd	22.00d	0.11a	2.64c	12.86c	352.20i	MS
Anmol	33.83g	0.08f	6.90c	11.70b	2.63a	3.16a	30.00a	0.13a	2.83b	13.70b	485.60a	MS
Captan	34.60f	0.11d	8.00b	11.66b	2.40abc	2.70bc	26.30c	0.18a	2.42d	13.63b	427.60d	MS
Local	38.70e	0.08f	8.03b	10.00d	2.03e	2.52d	29.00ab	0.12a	2.60c	12.00d	419.30e	MS
Sancanto	44.76d	0.09ef	7.70b	9.26e	2.60ab	2.16e	26.00c	0.11a	2.15e	11.76d	329.90j	S
Nakrsan	45.70c	0.10de	8.60a	13.76a	1.76d	2.28e	28.30b	0.09a	2.19e	15.86a	354.80h	S
Kargil	46.70b	0.10de	6.60d	9.93d	2.00bcd	2.75bc	29.70ab	0.09a	2.59c	12.00d	430.20b	S
Cucumber-363	51.90a	0.13c	6.03de	8.03f	1.96cd	3.23a	20.00e	0.08a	3.15a	10.00e	429.60c	S
LSD	0.29	0.01	0.40	0.47	0.62	0.16	1.56	0.12	0.15	0.31	0.18	

DWR = Dry weight of roots , DWS = Dry weight of shoots FWS = Fresh weight of shots FWR= Fresh weight of roots, SL = Shoot length, RL= Root length

DISCUSSION

This study was carried out to identify source of resistance against downy mildew caused by *Pseudoperonospora cubensis.* The resistance sources provides basis for development of resistant cultivars. The study revealed that disease reaction in cucumber plants remained varied. Among them none of the variety was observed to be immune to *Pseudoperonospora cubensis.* Genotype Hilton showed resistance with disease incidence of 18.26 % and rating scale of 3. Five genotypes namely HCU-163A, Panda India, Anmol, Captan and Local with disease incidence ranging from 31.73 to 38.70 % were moderately susceptible (MS) with rating scale 6. Sancanto, Nakrsan, Kargil and Cucumber-363 with disease incidence of 44.76, 45.70, 46.70 and 51.90 respectively remained susceptible (S) with rating scale 7. The response of resistant genotype in cucumber is due to recognition of host plant by its pathogen .The results of present study are in line with the findings of Call, (2012) who found that among 1300 tested cucumber genotypes, no genotype was immune and only 20 were highly resistant. Reshmi (2006) revealed that in screening of 114 cucumber genotypes against downy mildew, 10 were resistant, 18 moderately resistant, 37 moderately susceptible and 49 with susceptible reaction. Reshmi (2006). Criswell et al. (2008) also found resistant sources for *Pseudoperonospora cubensis* in cucumber.

Data regarding growth parameters also showed significant difference among the evaluated genotype. Maximum dry weight of root (0.17 gm) and shoot (8.60 gm) was observed in Panda India and Nakrsan respectively. Fresh weight of shoot (13.76g) and root (2.63g) was recorded in Nakrsan and Anmol. Maximum plant weight 15.86 g and fruit weight per plant 485.60g was observed in Nakrsan. Cucumber 363 had maximum shoot length of 3.15m.Moreover disease has minor effect on foliage of cucumber plants. Better development of foliage of crop led to more number of fruits per plant, longer and heavier fruit with higher yield (Chaudhry *et al.,* 2009).

CONCLUSION

Genotypes having resistance, moderately susceptible and susceptible response have been identified.. Hilton showed less disease incidence and was resistance but quantitatively less in growth parameters recorded. Genotypes with moderately resistant were significantly high with respect to growth parameter. A breeding program utilizing high yield susceptible and resistant with low yield, can have significant impact in disease loss and yield.

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Sabir H. Khan	:	Supervised the research
Iqra Mubeen	:	Wrote paper
Abdul Jabbar	:	Helped in field trails
Kiran Fatima	:	Analyzed the data
Muhammad Usman	:	Conducted the research trails
Naveed Aslam	:	Helped in manuscript writeup