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Effect of plant extracts against stripe rust of barley caused by *Puccinia striiformis* f. sp. *hordei*

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ABSTRACT

Effect of plants leaf extracts, *i.e*. Garlic, Oak, Neem, Dathura, Partheneium, Tulsi, Castor and Ashwagandha were studied at four different concentrations (3, 5, 10 and 15 %). Barley stripe rust disease was tested on susceptible barley cultivar RD 2035 under artificial rust inoculation conditions during two consecutive *Rabi*, seasons 2016-17 and 2017-18 in cage house. All concentration of eight plants leaf extracts increased per cent disease suppression and decrease the per cent disease severity, than in the control. Among these extracts garlic clove extract proved as best with highest per cent disease suppression (53.10) and significantly low mean per cent rust severity (39.78) followed by leaf extracts of neem (*Azadirachta indica*), tulshi (*Ocimum tenuiflorum*), datura (*Datura stramonium)*, oak (*Calotropics gigantean*), partheneium (*Parthenium hysterophorus*), castor (*Ricinus communis*) and ashwagandha (*Withania somnifera*).

Key words : *Stripe rust, Barley, Leaf extracts, Puccinia, Garlic, Neem.*

Introduction

Stripe rust disease of barley caused by *Puccinia stripe* f. sp. *hordei* Eriks. has always been one of major constraint in barley production. It causes several yield losses that could reach 66% on susceptible cultivars in the trans-Himalayan region of India (Vaish *et al*., 2011). Indiscriminate use of pesticide is an important cause of environmental pollution resulted in human and animal health hazards. The use of pesticide for pest control in agriculture especially in cereal crops should always be discouraged. Diseases can seriously reduce grain quality and final yield resulting in a lower profit to farmers. Eco-friendly control measures including plant extracts and organic materials, which act directly on the plant pathogen or indirectly by inducing resistance in plants, have gained considerable attention as alternative means to synthetic fungicides, Shabana *et al*., (2017). Most research on control has been focused on the use of fungicides and host plant resistance. These plant extracts are often less toxic and less persistent so they are assumed to be environmentally more acceptable and less hazardous to humans and animals. The effect of plant extracts are known for non-pollutive, cost effective and non-hazardous mean of plant disease management. For this object, in present investigation some botanicals have been tested for their efficacy to manage the rust of barley under cage house conditions.

Materials and Method

The experiments were laid out in completely randomized design (CRD) with four replications. The eight plants extracts *viz*. Garlic, Oak, Neem,

Dathura, Partheneium, Tulsi, Castor and Ashwagandha were evaluated with different concentrations against stripe rust under artificial rust epiphytotic condition in cage house (Table 1). All eight different botanicals known for antifungal activity were tested against stripe rust at four different concentrations (3, 5, 10 and 15 %) under artificial rust inoculation condition during two consecutive *Rabi*, seasons 2016-17 and 2017-18 in cage house.

Stripe rust inoculums

Every season, in the first fortnight of November the fresh and pure inoculum of *Puccinia striiformis* f. sp. *hordei* (PSH) was obtained from ICAR-IIWBR Regional Station, Flowerdale, Shimla (H.P.) to carry out the experiments. The inoculums was consisting of viable uredospores of four predominating pathotypes viz., 57 (0S0), 24 (0S-1), M (1S0) and G (4S0) prevailing in the major barley growing areas of the country. Barley plants (cv. RD 2035) were sown in 25 cm earthen pots. The seedlings were inoculated with uredo-spores of mix pathotype (57, 24, M and G) in cage house at two leaf stage (10-20 Zadoks scale) using syringe technique. The pots of inoculated seedlings were incubated in moist cloth chamber for 48 hrs to provide artificial humid environment for promote rust infection.

Preparation of plant extracts - Fresh and healthy parts of plants were collected and washed thoroughly with clean water and finally with sterilized distilled water. These plant parts ground separately in grinder adding equal amount of sterilized distilled water to get stock solution. The mixture was squeezed with double-layered sterilized cheese cloth. The extract thus obtained was considered as 100 per cent concentration. All the extracts were diluted to 3, 5, 10 and 15% with distilled water.

Data on stripe rust was recorded by combining severity (per cent leaf area covered by rust) and response (infection type). Scoring on stripe rust was recorded on the basis of modified Cobb scale (Peterson *et al*., 1948). The following formula was used to calculate the percentage of disease suppression.

$$\text{Disease suppression} = \frac{\text{Rust severity (control)} - \text{Rust severity (Treatment)}}{\text{Rust severity (control)}} \times 100\%$$

Results and Discussion

All the plant leaf extracts were found less effective as compare to fungicides however they were recorded as effective in reducing the stripe rust as their concentration increased. The most effective plant extracts in this regard were garlic (*Allium sativum*) clove extract (45.95, 43.20, 37.47 and 32.08 %) followed by neem (*Azadirachta indica*) leaf extract (54.55, 50.13, 44.95 and 41.90 %) and tulshi (*Ocimum tenuiflorum*) (56.97, 52.97, 49.10 and 44.53 %) at 3, 5, 10 and 15 per cent concentration respectively during both years and pooled data (Table 2). While ashwagandha (*Withania somnifera*), partheneium (*Parthenium hysterophorus*), oak (*Calotropics gigantean)*, castor (*Ricinus communis*) and datura (*Datura stramonium)* leaf extracts were found least effective at all the concentrations. However, standard check (tebuconazole @ 0.1%) was found best with minimum per cent disease severity (1.92, 1.28, 1.52 and 1.05 %) at 3, 5, 10 and 15 per cent concentration respectively during both the years and pooled data also (Table 2). Similar result obtained by Amaresh and Nargund (2003) the maximum per cent inhibition of uredospores germination with *Allium cepa* and *Allium sativum*. On the basis of the results obtained during the experiment revealed that tested plant extracts hold promise for the organic and eco-friendly management of rust disease of barley. The findings of this study was supported by

Table 1 The plant extracts and their concentrations (3, 5, 10 and 15%)

S. No.	Local Name	*Botanical Name*	Family	Plant Parts
1.	Garlic	*Allium sativum* L.	Amaryllidaceae	Clove
2.	Aak	*Calotropics gigantean*	Apocynaceae	Leaves
3.	Neem	*Azadirachta indica* Juss.	Meliaceae	Leaves
4.	Datura	*Datura stramonium*	*Solanaceae*	Leaves
5.	Parthenium	*Parthenium hysterophorus*	*Asteraceae*	Leaves
6.	Tulsi	*Ocimum tenuiflorum*	*Lamiaceae*	Leaves
7.	Castor	*Ricinus communis*	Euphorbiaceace	Leaves
8.	Ashwagandha	*Withania somnifera*	Solanaceae	Leaves

Table 2 *In vitro* efficacy of different plant extracts against *Puccinia striiformis* f. sp. *hordei*

S. No.	Treatments	Percent disease severity*											
		3%			5%			10%			15%		
		2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
1.	Garlic	44.57 (41.88)	47.33 (43.47)	45.95 (42.68)	41.53 (40.12)	44.87 (42.06)	43.20 (41.09)	37.27 (37.63)	38.47 (38.33)	37.87 (37.98)	32.03 (34.47)	32.13 (34.53)	32.08 (34.50)
2.	Oak	70.53 (57.12)	74.20 (59.47)	72.37 (58.29)	65.47 (54.01)	70.27 (56.96)	67.87 (55.47)	60.60 (51.12)	66.30 (54.51)	63.45 (52.80)	56.00 (48.45)	63.43 (52.79)	59.72 (50.60)
3.	Neem	53.33 (46.91)	55.77 (48.31)	54.55 (47.61)	48.67 (44.24)	51.60 (45.92)	50.13 (45.07)	42.07 (40.44)	47.83 (43.76)	44.95 (42.10)	38.53 (38.37)	45.27 (42.29)	41.90 (40.34)
4.	Dathura	66.13 (54.41)	71.63 (57.82)	68.88 (56.09)	62.83 (52.43)	68.77 (56.02)	65.80 (54.21)	57.63 (49.39)	65.37 (53.95)	61.50 (51.65)	54.03 (47.31)	58.57 (49.93)	56.30 (48.62)
5.	Partheneium	71.33 (57.63)	73.70 (59.15)	72.52 (58.38)	68.10 (55.61)	70.23 (56.93)	69.17 (56.27)	63.23 (52.67)	67.60 (55.30)	65.42 (53.98)	57.97 (49.59)	65.53 (54.05)	61.75 (51.80)
6.	Tulsi	55.60 (48.22)	58.33 (49.80)	56.97 (49.01)	56.97 (45.82)	54.50 (47.58)	52.97 (46.70)	46.50 (42.99)	51.70 (45.97)	49.10 (44.48)	49.10 (40.07)	47.63 (43.64)	44.53 (41.86)
7.	Castor	67.20 (55.06)	77.90 (61.96)	72.55 (58.40)	72.55 (53.35)	75.40 (60.27)	69.88 (56.71)	61.77 (51.81)	73.00 (58.69)	67.38 (55.17)	55.73 (48.29)	70.10 (56.85)	62.92 (52.49)
8.	Ashwagandha	73.63 (59.10)	80.43 (63.74)	77.03 (61.36)	71.60 (57.80)	77.63 (61.77)	77.63 (59.75)	66.73 (54.77)	75.07 (60.05)	70.90 (57.35)	63.53 (52.85)	71.50 (57.73)	67.52 (55.26)
9.	Stander check	1.80 (7.71)	2.03 (8.19)	1.92 (7.96)	1.07 (5.94)	1.49 (7.01)	1.28 (6.50)	1.23 (6.37)	1.80 (7.71)	1.52 (7.08)	1.02 (5.80)	1.09 (5.99)	1.05 (5.88)
10.	Control	80.03 (63.46)	90.50 (72.05)	85.27 (67.43)	80.17 (63.56)	87.37 (69.18)	83.77 (66.24)	81.20 (64.30)	89.00 (70.63)	85.10 (67.29)	80.53 (63.82)	89.63 (71.21)	85.08 (67.28)
S.Em.±C.D. at 5%		0.46	0.88	0.47	0.37	0.41	0.23	0.39	0.45	0.31	0.41	0.49	0.40
		1.39	**2.62**	**1.39**	**1.12**	**1.23**	**0.69**	**1.17**	**1.35**	**0.93**	**1.23**	**1.47**	**1.18**

*Mean of four replication, *Figures in parentheses are arcsineÖper cent angular transformed values
Table 3 *In vitro* efficacy of different plant extracts against *Puccinia striiformis* f. sp. *hordei*

other works on different crops and rust *viz.,* Gujar *et al*. (2012) found some plants contain compounds that are toxic to pathogens when extracted from plant and applied on infected crops. These compounds are called botanical pesticides or botanicals. Commonly used botanicals include plant extracts such as neem (*Azadirchta indica*, *A. juss*) and garlic (*Allium sativum*) and essentialoils. Chaudhary and Chaudhari (2013) observed that among the 20 plant extracts, maximum per cent germination inhibition of rust uredospores was recorded in garlic (*Allium sativum*) bulb extract followed by onion (*Allium cepa*) bulb and ginger (*Zingiber officinal*) rhizome. Tohamey and Hassan (2014) and Ayoub and Niazi (2001) observed that the *Puccinia recondita* was controlled by leaf extract of poisonous phanerogamic plants, *Narium odorum*, *Calotropis gigantea*, *Azadirachta indica* and *Datura strimonium* have 40.60, 45.45, 56.96 and 81.81% decrease of disease over control respectively in wheat. Whereas fungicide Baytan decrease the disease 84.84% this is at par with *Datura strimonium*. Similarly, Amaresh and Nargund (2003) observed the maximum per cent inhibition of uredospores germination with *Allium cepa* and *Allium sativum* at all the concentrations tested, *i.e.* 10.0, 7.0, 5.0 and 2.0 per cent. Thus, it could be concluded that plant extracts may be useful to control stripe rust disease as a safe alternative option to chemical fungicides.

Although, botanicals were not as effective as fungicide (tebuconazole 25.9%EC @ 0.1%)

Table 3 *In vitro* efficacy of different plant extracts against *Puccinia striiformis* f. sp. *hordei*

S. No.	Treatments	Disease suppression (%)		
		2016-17	2017-18	Pooled
1.	Garlic	51.73 (45.99)	54.32 (47.48)	53.10 (46.78)
2.	Oak	21.54 (27.65)	23.06 (28.70)	22.35 (28.21)
3.	Neem	43.28 (41.14)	43.75 (41.41)	43.54 (41.29)
4.	Dathura	25.25 (30.17)	25.83 (30.55)	25.57 (30.38)
5.	Partheneium	19.04 (25.87)	22.26 (28.15)	20.74 (27.09)
6.	Tulsi	39.44 (38.90)	40.47 (39.51)	39.99 (39.23)
7.	Castor	22.63 (28.41)	16.84 (24.23)	19.60 (26.28)
8.	Ashwagandha	14.42 (22.32)	14.52 (22.40)	14.49 (22.37)
9.	Standard check	98.41 (82.76)	98.20 (82.29)	98.30 (82.51)
10.	Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Figures in parentheses are arcsine**Ö**per cent angular transformed values

used as standard check. The efficacy of tested botanicals increased with the increase their concentration. Among the tested botanicals garlic clove extract proved as best with highest per cent disease suppression (53.10) and minimum per cent rust severity (39.78) followed by leaf extracts of neem (*Azadirachta indica*), tulshi (*Ocimum tenuiflorum*), datura (*Datura stramonium)*, oak (*Calotropics gigantean*), partheneium (*Parthenium hysterophorus*), castor (*Ricinus communis*) and ashwagandha (*Withania somnifera*) with per cent mean disease severity of 47.8, 50.89, 63.12, 65.85, 67.21, 68.18 and 72.52 respectively with per cent disease suppression of 43.54, 39.99, 25.57, 22.35, 20.74,19.60 and 14.49 respectively (Table 3).

Among the eight botanicals tested, garlic clove extract proved as best with highest disease suppression (53.10%) and significantly low mean per cent rust severity (39.78) followed by leaf extracts of neem (47.8), tulshi (50.89), datura, (63.12), oak (65.85), partheneium (67.21), castor (68.18) and ashwagandha (72.52) leaf extracts.

Conclusion

Among the botanicals, the efficacy of garlic clove extract was found best followed by neem leaf extract against the stripe rust, however plant extracts were found less effective as compared to fungicide tebuconazole 25.9% EC @ 0.1% used as standard check.

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