EVALUATION OF CONFIDOR 200 SL AGAINST WHEAT APHIDS, AND STUDY OF RELATIVE SUSCEPTIBILITY OF WHEAT GERMPLASMS TO *SITOPHILUS ORYZAE* (L.) (COLEOPTERA: CURCULIONIDAE)

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ABSTRACT

Two experiments were conducted to evaluate Confidor 200 SL against wheat aphids, and to study relative susceptibility of wheat germplasms against *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). Confidor 200 SL @ 400 ml/ha treatment was found most effective against wheat aphids. In all cases (except mixing of Confidor 200 SL @ 100 ml/ha with Tilt @ 0.01 %), Confidor 200 SL was found compatible with Tilt 0.01 %. In mixing, aphid incidence was found higher than the untreated control. In second experiment, wheat germplasms GW-1092, HUW-485, HD-2685, P-195, UP-2338, and UPD- 58 were found highly susceptible to *S. oryzae* (L.). These germplasms were followed by UP-2432, GW-298, P-210, PBW-676, GW-286, HP-1806, K-9503, P-133, P-61, and P-209. Percent infestation and percent weight loss were also recorded higher on these germplasms. However, the wheat germplasms C-2, MACS-2496, NIAW-158, VL-785, C-1, WH-917, and WH-673 were found least susceptible against *S. oryzae* (L.).

INTRODUCTION

Wheat is one of the most important cereal crops and staple food for the majority of human population. In India, wheat is the second important food crop and contributes about 35 percent of the total food grain production. It is a major contributor to the agrarian economy of the country (Nagarjan, 2000). Wheat production in India ranks second internationally with 11.4 percent of the world's wheat production (Hazra, 2000). However, the production is heavily affected by several insect pests at field as well as during storage. In the field, wheat crop is attacked by more than a dozen of insect pests since its sowing till harvesting (Bindra, 1968). Among the major insect pests of wheat in India, aphids have gained economic importance of regular pests and

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reported from all major wheat growing regions (Singh, 1986, 1988). While at storage, it is attacked by *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) including other stored grain insects pests (Kahre & Agrawal, 1962; Khare 1963).

Sitobion avenae (F.), and *Rhopalosiphum maidis* (titch) (Homoptera: Aphididae), are the most important among nine species of wheat aphids reported to infest wheat crop in wheat growing regions of India (Chaudhary *et al.*, 1968; Singh 1986). In the recent past, wheat aphids have gained a status of regular pests. Under favorable environment, wheat aphids reproduce at a faster rate, and may cause damage to 1-3 percent of total wheat production of the world (Metcalf *et al.*, 1951). For control of sap-sucking insects like aphids, Confidor 200 SL (imidacloprid) is being found an effective insecticide. Imidacloprid, which is an active ingredient of Confidor 200 SL, is a new class of chemical that differs from other conventional insecticides in its mode of action (Elbert *et al.*, 1991). Imidacloprid is chloro-nicotinyl insecticide, which gives outstanding control against sucking insects.

S. oryzae (L.) is one of the most destructive insect pests of stored grains (Cotton, 1960). It is an internal feeder, and causes heavy damage to wheat grains. *S. oryzae* (L.) is of cosmopolitan in distribution, and causes up to 50 percent weight loss in stored grains (Koura & El-Halfway, 1967). Stored grain insects pests including *S. oryzae* (L.) causes 5- 10 percent of loss to wheat at storage (Pradhan, 1964). However, the extent of damage differs greatly among different varieties/germplasms. Thus in this context, it is important to screen different germplasms for their susceptibility to different storage insect pests.

Considering the damage caused by aphids and efficacy of imidacloprid against sucking insects pests, and variability of damage caused by *S. oryzae* (L.) to different wheat germplasms, the present investigations were carried out to evaluate Confidor 200 SL against wheat aphids, and to study relative susceptibility of different wheat germplasms against *S. oryzae* (L.).

MATERIAL AND METHODS

The present investigations were carried out at the Crop research Center of G.B.Pant University of Agriculture and Technology, Pantnagar, India during the *Rabi* season, 2000-2001. A field study was conducted to evaluate Confidor 200SL (imidacloprid) against foliar aphids of wheat. Laboratory experiments were conducted to determine the relative susceptibility of different wheat germplasms to *S. oryzae* (L.).

TABLE (I)

Different wheat germplasms evaluated for their susceptibility to *S. oryzae* (L.)

Trt.	Germplasms	Trt.	Germplasms	Trt.	Germplasms	Trt.	Germplasms
T1	AKW 2276	T41	HD 2701	T81	MACS 2496	T121	PBW 428
T2	AKW 3294	T42	HDR 194	T82	MACS 2827	T122	PBW 429
T3	C-1	T43	HDR 201	T83	MACS 2829	T123	PBW 430
T4	C-2	T44	HI 1077	T84	MACS 3050	T124	PBW 676
T5	DD 72	T45	HP1633	T85	MACS 3063	T125	PBW 677
T6	DD 74	T46	HP 1805	T86	MACS 6080	T126	PBW 679
T7	DD 76	T47	HP 1806	T87	MP 1039	T127	PBW 680
T8	DD 78	T48	HP 1807	T88	MP 1040	T128	PDW 265
T9	DD 81	T49	HP 1808	T89	MP 1041	T129	PDW 266
T10	DL-975-4	T50	HP 1809	T90	MP 1042	T130	PDW 267
T11	DL-996-1	T51	HP 1810	T91	MP 1043	T131	PDW 268
T12	DL-994-8	T52	HP 1811	T92	MP 1044	T132	PDW 269
T13	DL-997-1	T53	HP 1812	T93	MP 4001	T133	UP 2338
T14	DL-1010-2	T54	HP 1813	T94	MP 5004	T134	UP 2433
T15	DL-1056-2	T55	HUW 48	T95	MPB 1046	T135	UP 2441
T16	DL-1107-3	T56	HUW 485	T96	MPO 1037	T136	UP 2442
T17	GW-285	T57	HUW 486	T97	MPO 1038	T137	UP 2443
T18	GW-286	T58	HUW 487	T98	MDW 10 44	T138	UP 2444
T19	GW-287	T59	HUW 488	T99	MDW 1047	T139	UP 2446
T20	GW-288	T60	HW 2022	T100	NIAW 79	T140	UP 2447
T21	GW-289	T61	HW 2099	T101	NIAW 139	T141	UP 2448
T22	GW-290	T62	ISW 43	T102	NIAW 152	T142	UP 2449
T23	GW-291	T63	ISW 44	T103	NIAW 158	T143	UP 2450
T24	GW-292	T64	ISW 45	T104	NIAW 160	T144	UPD 16
T25	GW-293	T65	ISW 46	T105	NIAW 172	T145	UPD 58
T26	GW-295	T66	K 9405	T106	NIAW 15	T146	UPD 59
T27	GW-297	T67	K 9501	T107	NW 1036	T147	UPD 61
T28	GW-298	T68	K 9502	T108	NW 1038	T148	VL 781
T29	GW-1092	T69	K 9503	T109	NW 1043	T149	VL 782
T30	GW-1144	T70	K 9504	T110	P 34	T150	VL783
T31	HD 2684	T71	K 9506	T111	P 39	T151	VL 784
T32	HD 2685	T72	K 9507	T112	P 52	T152	VL 785
T33	HD 2686	T73	K 9521	T113	P 61	T153	WH 669
T34	HD 2687	T74	K 9522	T114	P 133	T154	WH 670
T35	HD 2688	T75	K 9523	T115	P 195	T155	WH 671
T36	HD 2690	T76	K 9524	T116	P 209	T156	WH 672
T37	HD 2692	T77	K 9525	T117	P 210	T157	WH 673
T38	HD 2695	T78	K 9526	T118	P 217	T158	WH 917
T39	HD 2696	T79	K 9527	T119	PBW 426	T159	WH 918
T40	HD 2700	T80	K 9528	T120	PBW 427	T160	HDR 151
						T161	K 9124

Experiment 1- Evaluation of Confidor 200 SL against wheat aphids

An experimental plot, divided into three blocks was used in the study. One-meter wide border was left around the experimental field as well as in between the blocks. Block size was six rows of six-meter length. This experiment was conducted in a randomized design with seven treatments. Each treatment was replicated three times. In each replication the following treatments were used: T1- Confidor 200 SL @ 100 ml/ha, T2- Confidor 200 SL @ 200 ml/ha, T3- Confidor 200 SL @ 400 ml/ha, T4- Confidor 200 SL @ 100 ml/ha + Tilt @0.01%, T5- Confidor 200 SL @ 100 ml/ha followed by Tilt @0.01%, T6- Tilt @0.01% followed by Confidor 200 SL @ 100 ml/ha, and T7- Untreated control. Experimental field was prepared by ploughing after pre-irrigation. In each block the wheat seeds of variety UP2425 were sown on 9/12/2000. Seeds were sown by using a ferti-seed drill machine. Fertilizers were applied at the rate 120 Kg N, 60Kg P, and 40 Kg K per hectare at the time of sowing as well as after sowing. Weeds from the study filed and surrounding areas were removed frequently with manual operations.

For control of wheat aphids Confidor 200 SL was sprayed with the help of knapsack sprayer in different concentrations as per the layout of experiment. In addition to this, mixing of Confidor 200 SL with Tilt 0.01 % and spray of Confidor 200 SL followed by Tilt 0.01 % and *vice versa*, were also carried in order to study compatibility of imidacloprid with Tilt, and its impacts on aphid population. For population counts of wheat aphids, five plants were randomly selected in each plot. Aphid count was done one day before the spray. After the spray of pesticides, population counts of aphids were recorded at one day, two days, seven days and fourteen days of interval.

Experiment 2- Relative susceptibility of wheat germplasms to *S. oryzae* (L.)

Culture of *S. oryzae* (L.) was maintained prior to experiment. Clean wheat seeds without any infestation were used for maintaining the insect culture. Wheat seeds of 161 different germplasms were collected from the All India Coordinated Wheat Improvement Project, G. B. P. U. A. & T. Pantnagar Center (Table 1). Seeds of all experimental germplasms were kept in the laboratory for about one and a half month in order to acclimatize with laboratory environment. Grain moisture was recorded for all the experimental germplasms in order to avoid any biasness. To study relative susceptibility of 161 wheat germplasms (161 treatments) against *S. oryzae* (L.), healthy grains (50) of each germplasm were kept in small transparent and air-tight plastic vials. Five pairs of 1-5 days old *S. oryzae* (L.) were released in each vial. After 10 days, all adult insects were removed from the vials. After 30 days of insect release, observations were recorded for mean adult emergence, percent infestation and percent weight loss in

different wheat germplasms. Percent infestation was determined by counting the total number of infested grains. Head-lenses were used to check infestation. Percent weight loss was calculated by deducting the final weight of grains from its initial weight. Experiment was replicated 3 times with all 161 treatments.

Statistical Analysis

In both studies, all data sets were subjected to statistical analyses. An analysis of variance (ANOVA) test was used to compare data collected from each treatment during the experiment. Post Hoc tests (Tukey HSD and LSD) for multiple comparisons were also performed using the SPSS 14.0 statistical package.

RESULTS AND DISCUSSION

Wheat aphids study

Before one day of spray, the number of aphids per tiller were ranged from 9.07 (Confidor 200 SL @ 400 ml/ha) to 12.46 (Confidor 200 SL @ 100 ml/ha + Tilt @ 0.01%) treated plots (Figure 1). But the populations of wheat aphids were non-significantly different from each other.

After one day of spray, maximum number (11.07) of aphids was found in the plot treated with Confidor 200 SL @ 100 ml/ha + Tilt @ 0.01% when mixed together, while the minimum (1.40 aphids/tiller) was observed in Confidor 200 SL @ 200 ml /ha treated plot. All the concentrations of Confidor 200 SL (100, 200, and 400 ml/ha), Confidor 200 SL @ 100 ml/ha followed by Tilt @ 0.01 % , and Tilt @ 0.01% followed by Confidor 200 SL @ 100 ml/ha, as well as untreated control varied non-significantly with each other. However, it varied significantly with Confidor 200 SL @ 100 ml/ha + Tilt @ 0.01% when mixed together, which is non-significantly differ with control. After 2, 7, and 14 days of spray, aphid population varied non-significantly, however the population of aphids decreased as the time collapse (Figure 1).

Overall, mean revealed that the highest concentration of Confidor 200 SL (400 ml/ha) was found most effective. While, Confidor 200 SL @ 100 ml/ha + Tilt @ 0.05 % was found least effective. The overall position of different treatments with respect to their effectiveness was as follows: Confidor 200 SL @ 400 ml/ha > Tilt @ 0.01 followed by Confidor 200 SL @ 100 ml/ha > Confidor 200 SL @ 100 ml/ha followed by Tilt @ 0.01 % > Confidor 200 SL @ 200 ml/ha > Confidor 200 SL @ 100 ml/ha > untreated control > Confidor 200 SL @ 100 ml/ha + Tilt @ 0.01 % when mixed together.

Wheat germplasms study

Significant differences were observed among different wheat germplasms for their relative susceptibility against *S. oryzae* (L.) (Figure 2). Mean adult emergence was ranged from 12 to 1.33 being higher on germplasms GW 1092, HUW-484, HD-2685, P-195, UP-2338, and UPD-58. Mean adult emergence was also found higher on germplasms UP-2433 (11.66), GW-298 (11.33), P-210 (11.33), PBW- 676 (11.33), GW-286(11), HP-1806 (10.66), K-9504 (11), ISW- 44 (10.3), K-9503(10.33), P-133 (11), P-61 (10.33), P-209 (10.66) , and MP- 5004 (10.66). However, the lowest mean adult emergence was observed for the germplasms C-2, MACS-2496, NIAW-158, and VL-785. Lower mean adult emergence was also found on germplasms C-1 (1.66), GW-289 (2.33), MACS-2827 (2.33), VL-784 (2.33), WH-917 (1.66), WH-673 (1.66), and NW-1043 (2.66) (Figure 2).

The minimum percent infestation was recorded in the germplasms NIAW-158 (2.67 %), which was not significantly different from the germplasms MACS-2496 (6 %), MACS-2827 (5.67 %), NIAW-79 (6.67 %), WH-917 (4.67%), C-1 (3.3 %), AKW-3294 (8.33 %), K-9525 (8.67 %), NW-1043 (7.33 %), VL-785 (7 %), VL-784 (8.67 %), C-2 (3.3 %). However, the maximum percent infestation was observed in the germplasm GW-1092 (68.67 %). Higher number of percent infestation was also observed in the germplasms GW-298 (59 %), HD-2685 (53.33%), and GW-286 (50.33 %). The range of percent infestation in rest of the germplasms was 9.33 to 48.33 % (Figure 2).

The maximum percent weight loss was observed in the germplasms GW-1092 (53 %), which was significantly higher than other germplasms, but statistically at par with germplasms HD-2684 (47.67%), GW-286 (45.67%), HUW-485 (43%), and HD-2700 (41.67%). In contrast, the minimum percent weight loss was observed in the germplasms C-2, and NIAW-158, in which 1.33 percent weight loss was recorded. Both germplasms were found significantly different from other germplasms, except C-1 (1.67%), MACS-2496 (2.67 %), VL-785 (4 %), WH-917 (2.33 %), and NIAW-79 (3.67 %) (Figure 2).

The results of wheat aphids experiment clearly revealed that the Confidor 200 SL @ 400 ml/ha treatment was most effective against wheat aphids. It could be due to comparatively higher concentration of insecticide than other treatments. In all cases (except mixing of Confidor 200 SL @ 100 ml/ha with Tilt @ 0.01 %), Confidor 200 SL was found compatible with Tilt 0.01 %. In mixing, aphid incidence was found higher than the untreated control, which might be due to some sort of antagonistic properties of Tilt to Confidor 200 SL, thereby incompatibility of these two chemicals were unable to control aphid population. However, this needs further investigations.

Similar observations on the efficacy of imidacloprid against aphids were also reported by other workers, notably Hernandez *et al.*, (1999), Altmann & Elbert (1992), and Elbert *et al.*, (1991). In a study, Gray *et al.*, (1996), found that imidacloprid-treated oat or wheat plants reduced adult longevity and fecundity of three cereal aphid species over non-treated plants. Pike *et al.*, (1993) observed compatibility of imidacloprid with fungicides used in the seed treatments of wheat. These workers reported that the imidacloprid treatment, singly or in combination with fungicides used for wheat seed treatment protects wheat plants from the infestation of Russian wheat aphid. Similar findings were reported by Singh & Venkateshwarlu (2000).

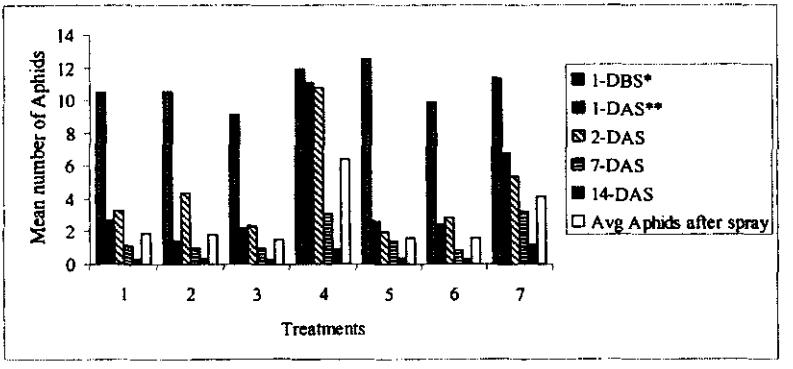

Figure 1. Effect of different treatments of Confidor 200 SL against wheat aphid populations. Different treatments include Confidor 200 SL @ 100 ml/ha (T1), Confidor 200 SL @ 200 ml/ha (T2), Confidor 200 SL @ 400 ml/ha (T3), Confidor 200 SL @ 100 ml/ha + Tilt @ 0.01 % (mixed together) (T4), Confidor 200 SL @ 100 ml/ha followed by Tilt @ 0.01% (T5), Tilt @ 0.01 % followed by Confidor 200 SL @ 100 ml/ha (T6), and untreated control (T7).

In screening of wheat germplasms study, all germplasms varied widely for their susceptibility to *S. oryzae* (L.). The germplasms GW-1092, HUW-485, HD-2685, P-195, UP-2338, and UPD- 58 were found highly susceptible to *S. oryzae* (L.). These germplasms were followed by UP-2432, GW-298, P-210, PBW-676, GW-286, HP-1806, K-9503, P-133, P-61, P-209, where mean adult emergence ranged from 10.33 to 12. Percent infestation and percent weight loss were also recorded higher on these germplasms, which shows their susceptibility to *S. oryzae* (L.). However, on the basis of mean adult emergence, the germplasms C-2, MACS-2496, NIAW-158, VL-785, C-1, WH-917, and WH-673 were found least susceptible against *S. oryzae* (L.). Tiwari (1999) found that the wheat germplasm UP-2338 was highly susceptible to *S. oryzae* (L.). In all germplasms, percent weight loss was found highly correlated with percent infestation (Figure 3). Similar observations on 15 different germplasms were also reported by Chatterjee (1955). Further evaluation on biochemical analysis of these different wheat germplasms is required to determine the actual cause of susceptibility.

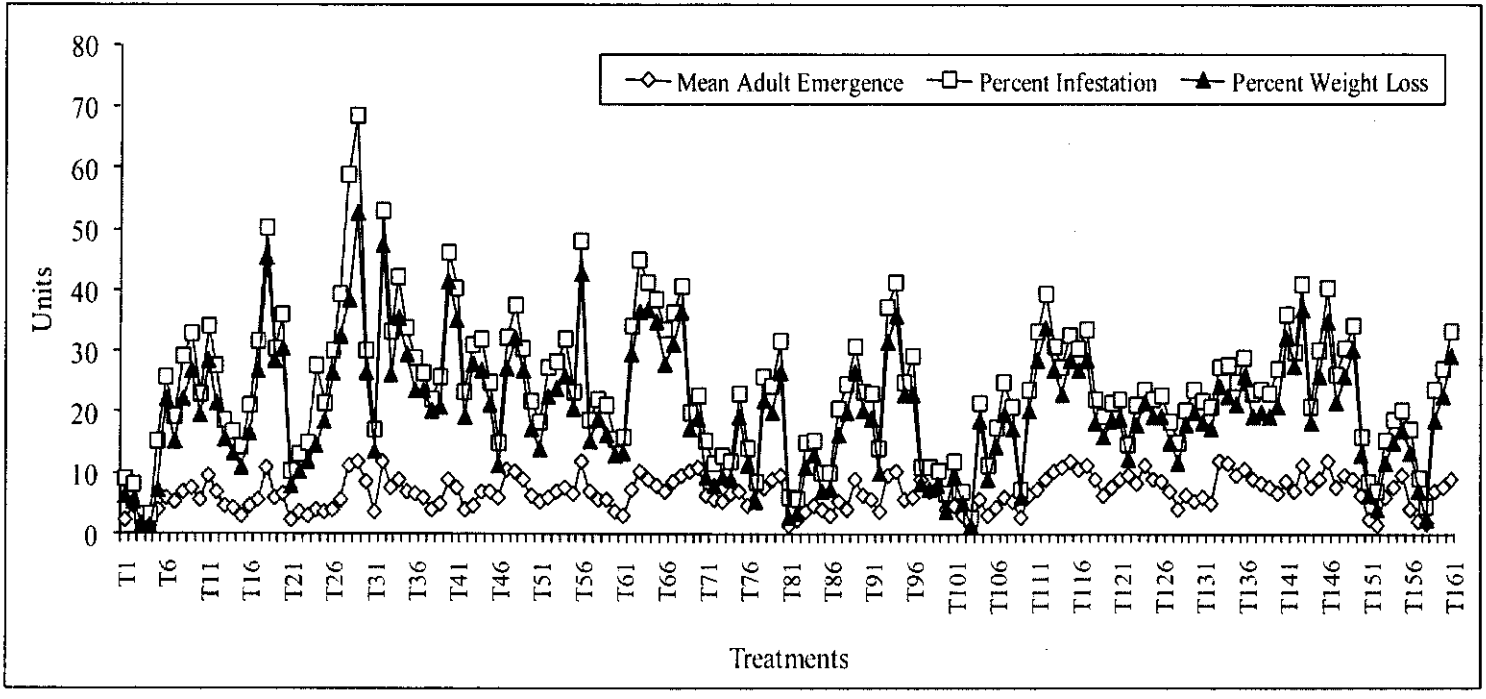

Figure 2. Mean adult emergence of *S. oryzae*, and percent infestation and percent weight loss in different wheat germplasms (treatments)

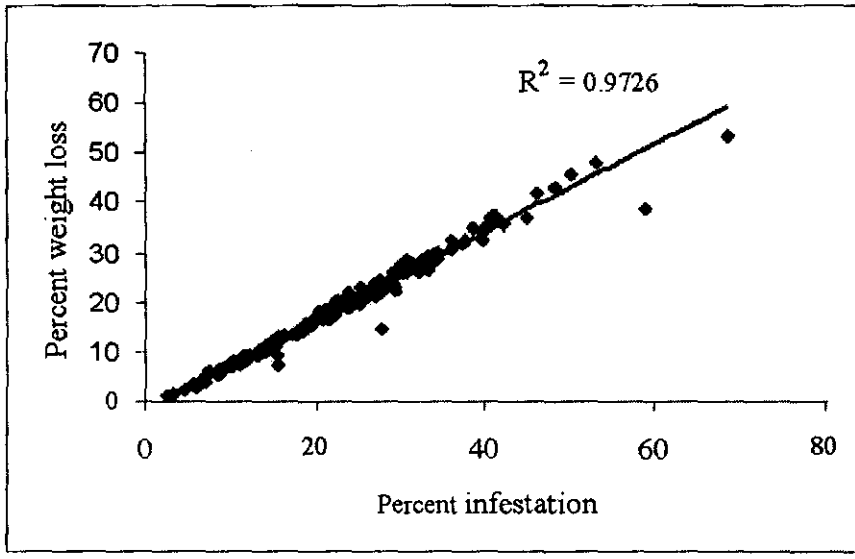

Figure 3. Correlation between percent weight loss and percent infestation caused by *S. oryzae* in different wheat germplasms

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