

Supplementary Files

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Clodinafop-Propargyl Herbicide Resistance Development in Winter Wild Oat (*Avena sterilis* subsp. *ludoviciana* (Durieu) Nyman) Influenced by Monoculture Cropping and Management Systems in Wheat Fields of Iran

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Table S1. Details of wild oat populations, herbicide application history, and crop rotation.

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
Ardabil	AR/BI1	Bilehsawar-Jafarabad	Wheat (5 years)	clodinafop propargyl (5 years)
	AR/BI2	Bilehsawar-Jafarabad	Wheat (5 years)	-
	AR/BI4	Bilehsawar-Jafarabad	Wheat (5 years)	clodinafop propargyl (5 years)
	AR/BI11	Bilehsawar -Central	Wheat (5 years)	clodinafop propargyl (5 years)
	AR/BI16	Bilehsawar-Jafarabad	-	-
	AR/BI17	Bilehsawar-Jafarabad	-	-
	AR/BI18	Bilehsawar-Jafarabad	-	-
	AR/BI19	Bilehsawar-Jafarabad	-	-
	AR/PA1	Parsabad-Central	-	-
	AR/PA2	Parsabad-KojeBiglo	-	-
	AR/PA3	Parsabad-Savalan	Wheat (5 years)	clodinafop propargyl (5 years)
	AR/PA4	Parsabad-Savalan	Wheat (5 years)	clodinafop propargyl (5 years)
	AR/PA6	Parsabad-Savalan	Wheat (5 years)	clodinafop propargyl (5 years)
Kermanshah	KR/G1	Qasr Shirin-Seyed Ahmad	-	-
	KR/G2	Qasr Shirin-Somar	-	-
	KR/G3	Qasr Shirin-Aghabar	-	-
	KR/GL1	Gilangrab-Deira	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year), sulfosulfuron (1 year)
	KR/GL2	Gilangrab-Shelin	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year), sulfosulfuron (1 year)
	KR/GL3	Gilangrab-Deira	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year), sulfosulfuron (1 year)
	KR/GL5	Gilangrab-Deira	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year), sulfosulfuron (1 year)
	KR/SP1	Sarpol Zahab-Central	Wheat (5 years)	clodinafop-propargyl (4 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year)
	KR/SP2	Sarpol Zahab-Pushtang	-	-

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
Khuzestan	KR/SP3	Sarpol Zahab-Central	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+ mesosulfuron-methyl+ mefenpyridiethyl (2 years)
	KH/AH1	Ahvaz-Gabir	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/AH2	Ahvaz-Melihan	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/AH3	Ahvaz-Elahi	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/AH4	Ahvaz-Moghtouh	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (1 year), sulfosulfuron (1 year), clodinafop propargyl (3 years)
	KH/BAG1	Baghmelk-Laran	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/BAG2	Baghmelk-Laran	Wheat (3 years), no cultivation (2 years)	clodinafop propargyl (3 years)
	KH/BAG3	Baghmelk-Midavad	Wheat (3 years), no cultivation (2 years)	clodinafop propargyl (3 years)
	KH/BAV1	Bavi-Seydanait	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/BAV2	Molasani-Weiss	Wheat (5 years)	clodinafop propargyl (5 years)
	KH/BE1	Behbahan-Salameh	Wheat (5 years)	clodinafop-propargyl (4 years), iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (1 year)
	KH/BE2	Behbahan-Islamabad	Wheat (5 years)	clodinafop-propargyl (4 years), iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (1 year)
	KH/BE3	Behbahan-Hazrat Ali	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (3 years), clodinafop propargyl (2 years)
	KH/DA1	Dasht Azadegan-Saadoun Hamidi	Wheat (5 years)	clodinafop-propargyl (5 years)
	KH/DA2	Dasht Azadegan-Suvidani	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (2 years), iodosulfuron-methylsodium+ mesosulfuron-methyl+ diflufenican+ mefenpyridiethyl (3 years)
	KH/DA3	Dasht Azadegan-Mihanabad	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (2 years), clodinafop-propargyl (2 years), sulfosulfuron (1 year)
	KH/DA4	Dasht Azadegan-Karon Hammadi	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (1 year), sulfosulfuron (1 year), clodinafop- propargyl (3 years)
	KH/DA5	Dasht Azadegan-Quds	Wheat (5 years)	sulfosulfuron (3 years), pinoxaden (1 year), clodinafop-propargyl (1 year)
	KH/HA1	Hamidiyeh-camp	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (3 years), clodinafop-propargyl (2 years)
	KH/HA2	Hamidiyeh Bilehsawar -Halaf	Wheat (5 years)	sulfosulfuron (2 years), pinoxaden (1 year), iodosulfuron-methylsodium+mesosulfuron- methyl+mefenpyridiethyl (1 year), clodinafop-propargyl (1 year)
	KH/HA3	Hamidiyeh-Gamboua Bozor	-	-
	KH/HA4	Hamidiyeh-Halaf	-	-
	KH/HE1	Handijan-Dere Mohak	-	-
	KH/HE4	Handijan-Cham Rahman	-	-
	KH/HO1	Hoyza-Saidah	-	-
	KH/HO2	Hoyza-Khor	-	-

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
Golestan	KH/IZ1	Izeh-Rasfand	-	-
	KH/IZ2	Izeh-Takab	-	-
	KH/KA1	Karun-Mozaffaria	-	-
	KH/LA1	Lali-Abshour	-	-
	KH/LA2	Lali-Tanbal	-	-
	KH/OM1	Omidiyeh-Qalahamud	-	-
	KH/OM2	Omidiyeh-Qalahamud	-	-
	KH/OM3	Omidiyeh-Jayzan	-	-
	KH/OM4	Omidiyeh - Vali	-	-
	KH/RM1	Ramhormoz-Zoidi	-	-
	KH/RM2	Ramhormoz-Qalasheikh	-	-
	KH/RM4	Ramhormoz-Zarafli	-	-
	KH/RS2	Ramshir-Azadeh	-	-
	KH/RS3	Ramshir-Azadeh	-	-
	KH/SH1	Shush-Benmaali	Wheat (3 years), no cultivation (2 years)	sulfosulfuron (2 years), clodinafop-propargyl (1 year)
	KH/SH2	Shush-Benmaali	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron-methyl+mefenpyridiethyl (2 years), pinoxaden (1 year), mesosulfuron+iodosulfuron (1 year), clodinafop propargyl (1 year)
	KH/SHO1	Shushtar-Qalhasid	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AG2	Aqqla-Central	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AG4	Aqqla-Aqul Temin	-	-
	G/AG5	Aqqla-Vashmghir	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AG6	Aqqla-Vashmghir	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AL4	Aliabad-Shering	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AL5	Aliabad-Zaringal	Wheat (5 years)	iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (2 years), clodinafop-propargyl (3 years)
	G/AL7	Aliabad-Shering	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/AZ1	Azadshahr-Khane Sadat	wheat (4 years), canola (1 year)	clodinafop-propargyl (4 years), cyclohexidine (1 year)
	G/AZ2	Azadshahr-Central	Wheat (5 years)	clodinafop-propargyl (4 years), iodosulfuron-methylsodium+mesosulfuron-methyl+ diflufenican+mefenpyridiethyl (1 year)
	G/AZ9	Azadshahr-Marzas	wheat (4 years), canola (1 year)	clodinafop-propargyl (3 years), sulfosulfuron+ metsulfuron-methyl (1 year), cycloxdim (1 year)
	G/G1	Gorgan-Aghabad	-	-
	G/G3	Gorgan-Agh Qala	wheat (3 years), barley (2 years)	clodinafop-propargyl (3 years)
	G/G4	Gorgan-Abad	-	-
	G/G5	Gorgan-Malek	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/G6	Gorgan-Malek	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/GA2	Galician-Loh	wheat (4 years), canola (1 year)	clodinafop-propargyl (4 years), cyclohexidine (1 year)
	G/GA3	Galiksh-Qanat	Wheat (5 years)	clodinafop-propargyl (4 years), pinoxaden (1 year)
	G/GM2	Gamishan-Goldasht	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/GM3	Gamishan-Khwaje Nafs	wheat (2 years), barley (3 years)	clodinafop-propargyl (1 year), iodosulfuron-methylsodium+mesosulfuron-methyl+ mefenpyridiethyl (1 year)
	G/GN7	Gonbad-Central	Wheat (5 years)	clodinafop-propargyl (5 years)

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
Fars	G/GN8	Gonbad-Central	-	-
	G/GN9	Gonbad-Baghel Valeh	wheat (3 years), canola (2 years)	clodinafop-propargyl (2 years), clodinafop-propargyl+ iodosulfuron-methylsodium+ mesosulfuron-methyl+ mefenpyridiethyl (1 year), cyclohexidine (2 years)
	G/GN10	Gonbad-Baghel Valeh	Wheat (5 years)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+ mesosulfuron-methyl+ diflufenican+ mefenpyridiethyl (2 years)
	G/KL2	Kalaleh-Aqo	wheat (4 years), canola (1 year)	clodinafop-propargyl (3 years), haloxyfoppimethyl (1 year), mesosulfuron+ iodosulfuron (1 year)
	G/KL6	Kalaleh-Central	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/KL9	Kalaleh-Central	Wheat (5 years)	clodinafop-propargyl (4 years), triasulfuron+ dicamba (1 year)
	G/KL10	Kalala-Khan Baba Mohammadi	wheat (4 years), canola (1 year)	clodinafop-propargyl (3 years), iodosulfuron-methylsodium+ mesosulfuron-methyl+ mefenpyridiethyl (1 year), cyclohexidine (1 year)
	G/MR1	Merawa Tepe-Kilidagh	-	-
	G/MR2	Merawa Tepe-Yanbalag	-	-
	G/MR5	Merawa Tepe-Glidagh	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/MR8	Merawa Tepe-Aqlo	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/RA4	Ramyran-Naghi Abad	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/RA7	Ramyran-Saadabad	Wheat (5 years)	clodinafop-propargyl (4 years), iodosulfuron-methylsodium+ mesosulfuron-methyl+ mefenpyridiethyl (1 year),
	G/RA9	Ramyran-Central	wheat (4 years), canola (1 year)	clodinafop-propargyl (4 years), haloxyfop-p-methyl ester (1 year)
	G/TR1	Turkmen-Pekar	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/TR2	Turkmen-Qara Tepe	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/TR3	Turkmen-Nizar	Wheat (5 years)	clodinafop-propargyl (5 years)
	G/TR4	Turkmen-Sijwan	Wheat (5 years)	clodinafop-propargyl (5 years)
	F/ES1	Esteban-Engirak	Wheat (5 years)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (4 years), clodinafop-propargyl (1 year)
	F/ES2	Esteban-Central	Wheat (4 years). Barley (1 year)	Clodinafop propargyl (2 years), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years)
	F/ES3	Esteban-Garde	Wheat (5 years)	Clodinafop propargyl (2 years), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years), Pinoxaden (1 year)
	F/ES4	Esteban	Wheat (5 years)	Clodinafop propargyl (3 years), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years)
	F/FA1	Farashband-central	Wheat (5 years)	Clodinafop propargyl (5 years)
	F/FI1	Fars-Firouzabad	Wheat (5 years)	Iodosulfuron-methyl-sodium+ Mesosulfuron-methyl+ diflufenican+ Mefenpyridiethyl (1 year), Clodinafop propargyl (3 years), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (1 year)
	F/FI2	Fars-Firouzabad	-	-
	F/KA1	Kazeron-Belian	Wheat (5 years)	Sulfosulfuron+ Metsulfuron-methyl (2 years), Clodinafop propargyl (3 years)

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
	F/KH1	Kharamah-Central	Wheat (3 years), Alfalfa (1 year), no cultivation (1 year)	Iodosulfuron-methyl-sodium+ Mesosulfuron-methyl+ diflufenican+ Mefenpyridiethyl (1 year), Clodinafop propargyl (2 years),
	F/KH2	Khorameh-Khizrabad	Wheat (3 years), no cultivation (2 years)	Clodinafop propargyl (3 years)
	F/KV1	Kvar-Asr	Wheat (3 years), no cultivation (2 years)	Clodinafop propargyl (3 years)
	F/KV2	Kvar-Quarkhene	Wheat (3 years), Sugar Beet (1 year), no cultivation (1 year)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years), Clodinafop propargyl (1 year), Haloxifop-P-methyl ester (1 year)
	F/M1	Marvdasht-Shul	Wheat (5 years)	Clodinafop propargyl (1 year), Sulfosulfuron (2 years), Pinoxaden (1 year), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (1 year)
	F/M2	Marvdasht-Abad	Wheat (5 years)	Clodinafop propargyl (2 years), Pinoxaden (1 year), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years)
	F/M3	Marvdasht-Marvdasht	Wheat (5 years)	Clodinafop propargyl (2 years), Pinoxaden (1 year), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years)
	F/M4	Marvdasht-Abad	Wheat (3 years), Barley (1 year), Canola (1 year)	Pinoxaden (1 year), Haloxifop-P-methyl ester (1 year), Diclofop-methyl (1 year), Clodinafop propargyl (1 year)
	F/M5	Marvdasht-Kamin	Wheat (5 years)	Clodinafop propargyl (2 years), Iodosulfuron-methyl-sodium+ Mesosulfuron-methyl+ diflufenican+ Mefenpyridiethyl (2 years), Pinoxaden+ Clodinafop propargyl+ Cloquintocet-mexyl (1 year)
	F/M6	Marvdasht-Ghale	Wheat (5 years)	Pinoxaden (2 years), Clodinafop propargyl (3 years)
	F/M7	Marvdasht-Shul	Wheat (5 years)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (2 years), Clodinafop propargyl (1 year), Pinoxaden (1 year), Iodosulfuron-methyl-sodium+ Mesosulfuron-methyl+ diflufenican+ Mefenpyridiethyl (1 year)
	F/M8	Marvdasht-Marvdasht	-	-
	F/PA1	Pasargad-Pasargad	-	-
	F/PA2	Pasargad-Kamin	Wheat (2 years), no cultivation (3 years)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (1 year) Clodinafop propargyl (1 year)
	F/PA3	Pasargad	Wheat (3 years), Sugar Beet (2 years)	Clodinafop propargyl (3 years), Haloxifop-P-methyl ester (2 years)
	F/PA4	Pasargad-Kamin	Wheat (5 years)	Clodinafop propargyl (5 years)
	F/PA5	Pasargad	-	-
	F/RO1	Rostam-Safie	Wheat (5 years)	Clodinafop propargyl (3 years), Iodosulfuron-methyl-sodium+ Mesosulfuron-methyl+ Diflufenican+ Mefenpyridiethyl (1 year), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenpyridiethyl (1 year)

Province	Population Code	Sampling Location	Crop rotation	Herbicide Application History of Fields
	F/RO2	Rostam-Central	Wheat (2 years), Sugar Beet (3 years)	Clodinafop propargyl (1 year), Sethoxydim (3 years), Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenepyradiethyl (1 year)
	F/RO3	Rostam-Alivand	Wheat (5 years)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenepyradiethyl (3 years), Clodinafop propargyl (2 years)
	F/RO4	Rostam-Pir	Wheat (4 years), Canola (1 year)	Mesosulfuron methyl+ Iodosulfuron methyl sodium+ Mefenepyradiethyl (2 years), Clodinafop propargyl (2 years), Cycloxydim (1 year)

Table S2. Sampling form of suspected herbicide resistance weeds.

Farmer Information		
Name:	Contact phone:	
Province:	City:	Village:
Weed suspected of resistance:	Herbicide suspected of resistance:	
Field Information	Herbicide Information	Weed Information
Geographical location of the Field:	Herbicides used this year:	Distribution of weed:
Longitude:		uniform ☐
Latitude:		One patch ☐
Altitude above the sea level:		Several patches ☐
Field approximate area:	Dose of herbicides used this year (Hectare):	Percentage of weed contamination of the field:
Cultivated crop this year:	Weed height at the time of spraying: Yes ☐ No ☐	Was this weed easily controlled in previous years?
Cultivated crops in the last five years:	Field soil moisture conditions during spraying:	Did this weed gradually become difficult to control?
1-	dry ☐	Yes ☐
2-	wet ☐	No ☐
3-		
4-	flooded and wet ☐	
5-		
Field soil type:	Herbicides used in the last five years:	Were there any signs of weed after spraying?
	1-	
	2-	
	3-	
	4-	
	5-	
	Are you satisfied with the herbicide you used?	
	Yes ☐ High ☐	
	Medium ☐ Low ☐	
	No ☐	
	If the answer is negative, how do you know the reason?	
Comments and suggestions:	Notice:	