Identifying and mapping wild oat (*Avena ludoviciana* Dur.) and little seed canarygrass (*Phalaris minor* Retz.) resistant biotypes to clodinafop-propargyl in wheat fields of Kordkuy, Iran

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ABSTRACT

To survey wild oat (*Avena ludoviciana* Dur.) and little seed canarygrass (*Phalaris minor* Retz) biotypes resistant to clodinafop-propargyl herbicide in wheat fields of Kordkuy, Golestan province, an experiment was conducted at Gorgan University of Agricultural Sciences and Natural Resources, Iran, during 2013. 44 and 85 suspected resistance biotypes of *A. ludoviciana* and of P. *minor*, respectively were collected from wheat fields by moving on grid map of Kordkuy. One susceptible biotype was also collected for each species from area which had never been applied by herbicides. Experiments included screening the suspected biotypes with discriminating concentration and concentration-response bioassay for resistant biotypes. The screening assays using discriminating concentration indicated that 15 and 12 biotypes of *A. ludoviciana* and *P. minor*, respectively were resistant to clodinafop-propargyl. Distribution maps of infected fields by resistant *A. ludoviciana* and *P. minor* biotypes were processed using GIS. Results of this study could be used for running programs to manage resistant weeds and to prevent the development of resistant biotypes to other parts of the region and distribution maps.

Keywords: Concentration-response bioassay, Herbicide resistance, little seed canarygrass, wheat and wild oat

INTRODUCTION

Grassy weeds notably *Phalaris minor* Retz and *Avena* spp are the two most competitive weeds infesting wheat fields in Iran. Littleseed canarygrass is a native weed of Mediterranean origin, and has spread to many parts of the world (Anderson 1961). Over all other weeds control methods, chemical weed control method is preferred because it is quick, more effective and relatively cheaper than other methods. Three aryloxyphenoxypropionate (APP) herbicides: fenoxaprop-P-ethyl (FEN), diclofop-methyl (DIC) and clodinafop-propargyl (CLD) are mostly recommended and used as post-emergence to control grass weeds like *Phalaris* spp. and *Avena* spp. in wheat crop (Délye et al., 2002). Aryloxyphenoxy propionate herbicides inhibit the chloroplastic acetyl coenzyme A carboxylase (ACCase) action in the Poaceae family, preventing fatty acid synthesis and reducing the production of the phospholipids that are used in the membranes (Délye et al., 2002). Resistance has previously been reported for biotypes of *Avena* spp and *Phalaris minor* (Heap, 2014).

Advances in technologies such as global positioning systems (GPS), remote sensing (RS) and computer integrated farm equipment (VRT) offer the potential for site specific and locally varying weed management. The availability of Geographic information systems (GIS) allows to generate variable herbicide application maps in order to apply herbicides only in those portions of the field in which weeds are present .

Aim of this study was to detecting and mapping *P. minor* and *Avena* spp resistant biotypes to clodinafop propargyl in Kordkuy city, Golestan province located in the north of Iran.

MATERIALS AND METHODS

Plant material

Seeds of suspected resistant biotypes of *Avena ludoviciana* Dur and *Phalaris minor* Retz were collected from 120 wheat fields by moving on Kordkuy's map. The susceptible population was from areas which had never been applied by herbicides.

Discriminating concentration

Discriminating concentration (0.16 mg ai L-1, 0.067 mg ai L-1 for *A. ludoviciana* and *P. minor* estimated, respectively.) was applied to collected biotypes. Then, the seedling length data were expressed as percentage of the untreated control. Biotypes that their seedling length significantly differed from susceptible biotype were considered as resistant biotype.

Concentration-response assay

Several concentrations above and below the discriminating concentration applied for resistant and susceptible biotypes to obtain the resistance factor (RF). The applied doses were: (0, 0.005, 0.01, 0.02, 0.04, 0.08, 0.16, 0.32 and 0.64 mg. ai. L-1) and (0, 0.005, 0.02, 0.08, 0.32, 1.28, 5.12, 20.48 and 40 mg. ai. L -1) for *A. ludoviciana* and *P. minor*, respectively

Statistical analysis

Using non-linear regression analysis on the R software (drc add-on package), the three-parameter log-logistic model (Equation 1) was fitted to data and EC50 values were estimated for each population (Ritz and Streibig, 2005)

Equation 1 $$f(x,(b,d,e)) = \frac{d}{1+\exp\{b(log(x)-\log(e))\}}$$

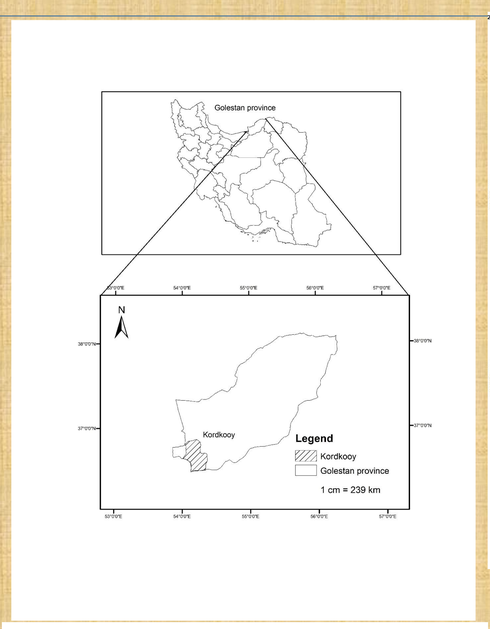
where e is the EC50. The upper limit is d. The parameter b denotes the relative slope around e.

Distribution map

During sampling, the geographical coordinates of the sampling points was recorded using GPS map60. The Recorded data convert by mapsource software to be read in GIS software .

RESULTS

The results showed that 31 of 44 suspected resistance biotypes of *A. ludoviciana* and 12 of 85 of suspected resistance biotypes of *P. minor* were resistant to clodinafop propargyl. Concentration-response experiment showed different resistance factors for the 12 resistant biotypes of *P. minor* (PM_{193}, PM_{181}, PM_{210}, PM_{207}, PM_{158}, PM_{119}, PM_{163}, PM_{79}, PM_{101}, PM_{450}, PM_{449}, PM_{186}). The RF were: 32.59, 28.38, 25.21, 21.46, 17.74, 6.88, 5.20, 7.64, 3.82, 7.99, 5.79, 5.69. Topics Mapping of resistant grasses provides a good overview about the distribution of resistance at local- and global-level, the speed of the spread of new biotypes to a given mode of action, the threat of new species to develop resistance and the detection of weed shifts and escapes. Local weed mapping is very useful to plan Integrated Weed Management strategies at local scale. The implementation of IWM strategies (chemical diversity, crop rotation and different cultural practices) will play a key role in the future.



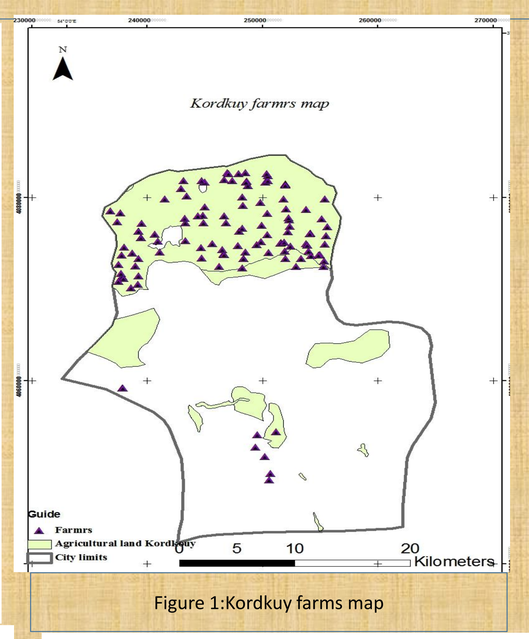


Figure 1:Kordkuy farms map

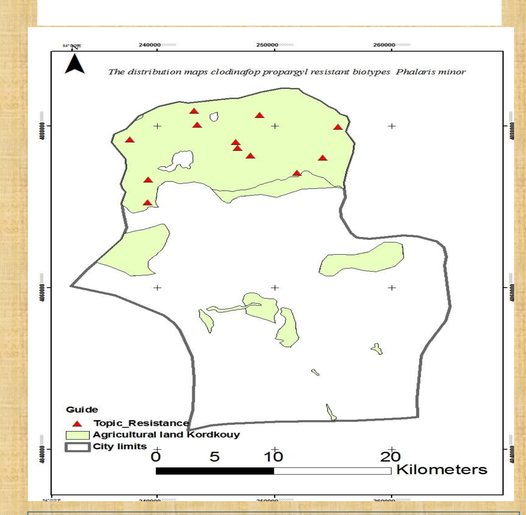


Figure3: Distribution of farms which infected by *Phalaris minor* biotypes resistant to clodinafop propargyl

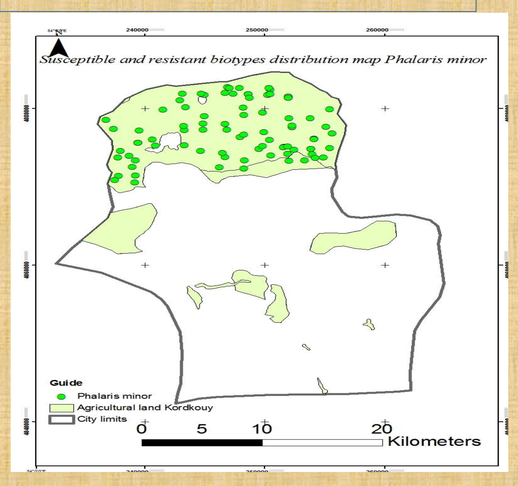


Figure 2: Collected farms which infected by *Phalaris minor*

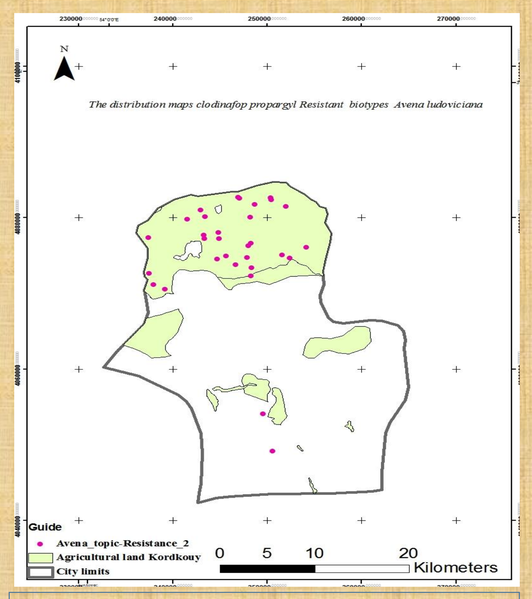


Figure 5: Distribution of farms which infected by *Avena ludoviciana* biotypes resistant to clodinafop propargyl

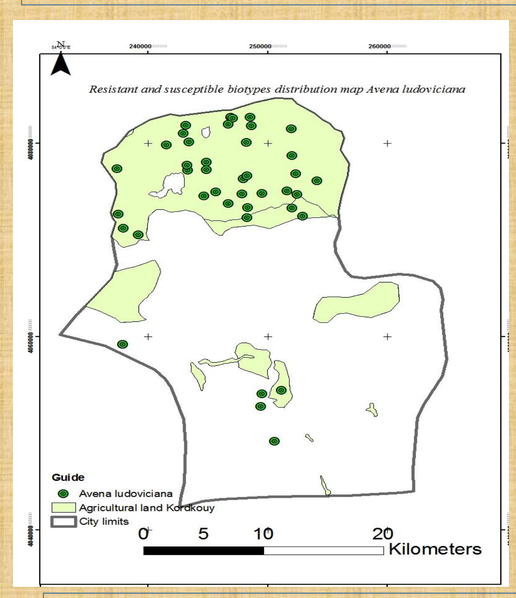


Figure 4: Collected farms which infected by *Avena ludoviciana*

REFERENCES

Anderson D.E. 1961. Taxonomy and distribution of the genus Phalaris. Iowa State J. Sci. 36 (1): 1–96.

Delye C, Wang T, Darmency H (2002). An isoleucine leucine substitution in chloroplastic acetyl CoA carboxylase from green foxtail (Setaria viridis L. Beauv.) is responsible for resistance to the cyclohexanedione herbicide sethoxydim. Planta. 214: 421-427.

Ritz, C., and Streibig, J. C. 2005. Bioassay analysis using R. Journal of Statistical Software. 12 (5): 1-22

Travlos I.S., Economou G., Kotoulas V.E., Kanatas P.J., Kontogeorgos A.N., Karamanos A.I. 2009. Potential effects of diurnally alternating temperatures on purple nutsedge (Cyperus rotundus) tuber sprouting. J. Arid Environ. 73 (1): 22–25. .

Heap, I. M. 2013. International Survey of Herbicide Resistant Weeds. Available at: http://www.weedscience.org/summary/MOASummary.asp. Accessed: 12 June 2013