Detection Survey Protocol for *Avena ludoviciana* (Durieu) in Medicinal and Aromatic Plants Nepal

Government of Nepal
Ministry of Agriculture and Livestock Development
Plant Quarantine and Pesticide Management Centre
Hariharbhawan, Lalitpur

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NPPO-Nepal, 2025

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A. General Information

1. Background Information

1.1 Introduction

The genus *Avena* consists of a diverse group of species, including both cultivated and wild varieties, which are distributed across different geographical regions. Among them, *Avena ludoviciana* (Durieu), commonly known as wild oat, is a significant weed species that has been reported to affect various agricultural and medicinal plant ecosystems. This species is known for its adaptability and competitive nature, often invading crop fields, pastures, and natural habitats, thereby posing a threat to plant diversity and agricultural productivity. In the context of Nepal, where medicinal plants hold immense economic and ecological value, the presence of *Avena ludoviciana* can lead to resource competition, reduced yield, and potential alterations in the chemical composition of medicinal plants. Therefore, the detection survey protocol for *Avena ludoviciana* is crucial in assessing its occurrence, distribution, and impact on medicinal plant cultivation and wild populations. A systematic approach involving field surveys, species identification, and risk assessment is essential to develop effective management strategies and safeguard the sustainability of medicinal plant resources in Nepal.

Avena ludoviciana (Durieu) or wild oat is a weed that can create serious challenges to the crops worldwide. It is predominantly found in temperate climate as well as in semi-arid and subtropical regions. Presence of this weed has been recorded across all continent except Antartica till date (CABI, 2022). Due to its unique seed properties such as successful germination ecology, high competitive ability, and allelopathic potential, this weed species is highly adaptable and can grow in both temperate and subtropical climates. Wheat, oats, barley, canola, maize, alfalfa, sunflower, and other important winter and spring crops are grown there. Depending on the crop variety and weed density, yield losses can reach 70% in cultivated crops (Bajwa et al., 2017). *Avena ludoviciana* serves as a host for several significant agricultural pests and pathogens like *Fusarium oxysporum* (the causative agent of basal rot) *Haplothrips tritici* (wheat thrips), *Rhipidothrips gratiosus* and *Sclerotinia sclerotiorum* (cottony soft rot) (CABI, 2022). Wild oat (*A. ludoviciana*) is a winter season weed found in different places of Nepal. It can tolerate wide range of management practices and it is problematic in conventional field (Maharjan & Chauhan, 2023). It has been declared as quarantine pest of medicinal plants like *Swertia chirayita, Phyllathus emblica, Cassia obtusifolia,* etc. by China. This might create obstruction in the export of highly potential medicinal plant of Nepali origin to China. To comply with the obligation of GACC standard requirement, survey has to be done in the area where medicinal plants are being produced or collected to detect for the presence of *A. ludoviciana*.

The detection survey of *A. ludoviciana* focuses on identifying its presence and distribution to provide informed control measures in the targeted survey area. This survey protocol includes specific guidance on sampling methods, biology and identification of the specimen. By addressing these factors, the guideline aims to ensure that Nepal's exports meet GACC standards to facilitate trade while ensuring phytosanitary safety in the importing country, China.

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Identity and taxonomy of target pest

Taxonomic tree

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Monocotyledonae
Order: Cyperales
Family: Poaceae
Genus: *Avena*

- Species: *Avena ludoviciana* (Durieu)

Common name: Winter wild oat

Source: (CABI, 2022)

Botanical description

Wild oat is an upright annual weed. It has long broad leaves having bright green color. During early stage its plants resemble with wheat and cultivated oat, but at mature stage this weed is taller than wheat.

The leaves of *A. ludoviciana* have obtuse to acute ligule that measures about 0.5–8 mm in length. The leaf blades can reach up to 18 mm in width and may sometimes have scattered long hairs. The panicle is loose and pyramidal in structure whose length is 10 to 45 cm. The spikelet is about 25–30 mm long and typically contain two or three florets. Disarticulation occurs between the glumes and the lowest lemma. The glumes are sub-equal, acute and measures about 14–32 mm in length. The glumes have smooth and glabrous surface. Lemmas are ovate and 10–25 mm in length. The basal 60% is covered in long silky hairs. The tip of lemmas are notched with short teeth. The two lower florets are awned that is around 17–60 mm in length. The awns are geniculate and twisted that aids in seed dispersal (Jacobs & Hastings, 1993). The growth and reproductive phase of *A. ludovaciana* is described below:

1.2 Germination (Autumn/Winter)

Avena ludoviciana germination and growth pattern is influenced by environmental conditions like temperature and soil moisture. Its germination is more favorable at low temperatures compared to other *Avena* species such as *A. fatua*. *A. ludoviciana* thrives in cooler temperatures. Researches have shown that both species can germinate across a wide temperature range from 5 to 30°C. The germination was recorded to initiate after 32 GDD. At the temperature of 10 to 18°C, germination% is similar in both species. However, at temperatures above 20°C, germination is higher in *A. fatua*, whereas *A. ludoviciana* shows superiority below 10°C (Bajwa et al., 2017).

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1.3 Vegetative growth (Late Autumn to Early Spring)

After germination, the plant enters a vegetative phase characterized by the development of long, narrow leaves and tillering. This phase occurs during winter, where the weed competes with winter crops like wheat for light, nutrients, and water. The optimum temperature for growth is around 20°C during the day and 12°C at night. Photoperiod and light intensity also influences the growth stages. Low light causes significant reduction of biomass (Turkseven, 2024). It was recorded that the tillering occurs at 473 GDD (CABI, 2022).

1.4 Reproductive stage (Spring)

As temperatures rise in spring, *A. ludoviciana* transitions to its reproductive phase by producing panicles or inflorescences (Jacobs & Hastings, 1993). It has been found that flowering occurs at 1493 GDD, dough stage at 2112 GDD and the life cycle is completed at 2423 GDD (CABI, 2022).

1.5 Seed maturation and dispersal (Late Spring to Early Summer)

Seeds matures in late spring and are shed in the field. The awns helps in seed dispersal by adhering to animals, farm equipment, or by wind. Some seeds might fall directly to the soil. The plants of *A. ludoviciana* are prolific seed producers with an estimated produce up to 4000 seeds per plant (Mahajan & Chauhan, 2023).

Field identification

Identifying *A. ludoviciana* in the field can be done by observing its morphological characteristics. Sometimes it may be confusing with other *Avena* sp. particularly *A. fatua*. However, it can be differentiated, especially at the reproductive stages. The key traits as mentioned by Bajwa et al. (2017) for field identification are described below:

- **Growth habit and height**: *A. ludoviciana* is about 2 meters tall with spreading and loose panicles. While, A. fatua is shorter than *A. ludoviciana* (about- 1.5 meters) and has loose, drooping panicles with open branches.
- **Leaf**: The leaves of *A. ludoviciana* have a ligule (> 5 mm), distinguishing it from *A. fatua*. Both species are broad leaved but, the leaf blades of *A. ludoviciana* is more elongated and membranous.
- **Stem and tillering**: The stem of *A. ludoviciana* is prostrate type. It has numerous tillers at the maximum tillering stage. While, *A. fatua* has an upright stem with fewer tillers giving it a more erect growth form.
- **Pre-flowering stage**: Before flowering, *Avena* species can be separated visually from wheat and barley by examining the collar region. Wheat and barley have auricles and short ligules while *A. ludoviciana* have no auricles and long ligules.
- **Panicle and Spikelet**: The panicles of *A. ludoviciana* are less dense and bear fewer florets when compared to *A. fatua*. The glumes in *A. ludoviciana* are longer (25–30

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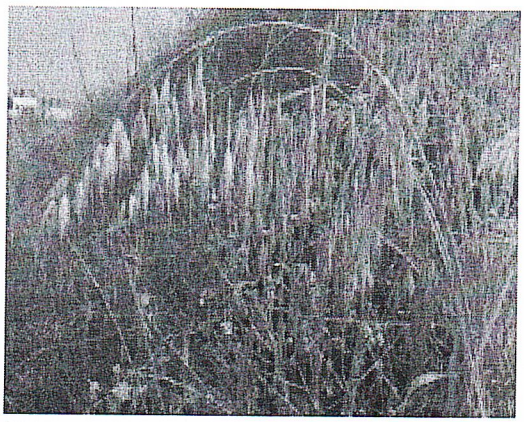
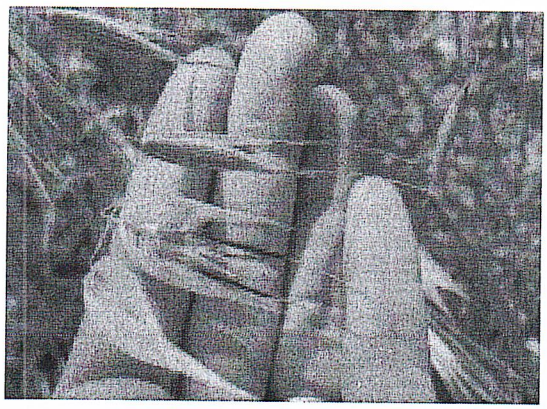
mm) compared to those of *A. fatua* (18–25 mm).The spikelets of *A. ludoviciana* have 3–5 florets but *A. fatua* has only 2–5 florets.

- **Awn and Seed**: In *A. ludoviciana*, the first and second seeds in a spikelet are awned, but the third seed lacks an awn. In contrast, all seeds in *A. fatua* are awned. *A. ludoviciana* seeds are retained till maturity and shed in units of 2 to 3 seeds. While, *A. fatua* shed its seeds individually.

a) Seed head



b) Growth Habit



c) Panicles

d) Seed

Fig. 1: Different stages of *A. ludovacianum* for field identification

Source: (CABI, 2022)

Mode of dispersal

A. ludovaciana is dispersed through wind, birds, animals and other humans. However, wind is of least significance in the dispersal of *A. ludovaciana.* Birds and other animals collect, store and drop the seeds of *A. ludovaciana.* It was reported that *A. sterilis* was accidentally introduced in Europe and India anthropogenically (CABI, 2022). Hence, movement of humans and goods can be the significant mode of dispersal of this pest. Agricultural activities also add transporting the seeds through contaminated agri-equipments and vehicles.

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B. Detection Survey

Purpose of survey

The purpose of this survey is to detect *A. ludoviciana* in the survey area where medicinal plants are grown. The protocol would facilitate identifying and documenting presence of *Avena ludoviciana* in different agroecological regions of Nepal.

The objective of the survey is safe exports of plant/plant materials from Nepal to the importing country (China). The spread of plant /weed seeds occurs due to trade/travel and others. So, the chances of entering weed from the infested area to non-infested area within different parts of the country or other countries is expected to be high.

Scope

The survey will be done based on the availability of the host species. The availability of host species is determined on the basis of host distribution survey conducted by the institutions like;

Department of Plant Resources,
Department of Forest and soil conservation,
National Herbarium and Plant Laboratories, and other related institutions like
Central Department of Botany of Tribhuvan University,
Agriculture and Forestry University, Rampur, Chitwan
TU/IAAS, Kathmandu
Development partners (I/NGO),
National Herbarium and Plant Laboratories (NHPL), Godawari, Lalitpur
Natural History Museum, Swoyambhu, Kathmandu
National Agronomy Research Centre, Khumaltar, Lalitpur
Central Agricultural Laboratory, Hariharbhawan, Lalitpur
Plant Protection Laboratories and other relevant laboratories.

Target pest

Preferred Scientific Name: *Avena Ludoviciana* L.
Other Scientific name: *Avena persica*,
Avena sativa subsp. sterilis,
Avena sterilis subsp. trichophylla,
Avena trichophylla
Preferred Common Name: winter wild oat

Source: (EPPO, 2004)

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Timing of survey

A. ludoviciana is an annual winter season weed. Hence, the survey should be carried in the winter season (Nov- Feb) during vigorous vegetative growth stage and at flowering stage. During this stage it is easier to detect and control this weed through various technique (Kaur et al., 2010).

Location of survey

The survey shall be conducted in the locations where the medicinal plants are being produced or collected and also in the periphery area of the medicinal plants fields. The location may be wild forest area or cultivated fields. The survey plan will describe the specific survey location.

Method of detection

- **Detection through direct field observation:** The visual inspection is most effective during active vegetative growth stage (Kaur et al., 2010). It is an annual winter season weed. Hence, visual inspection should be carried out in the winter season to identify the weed using key morphological features. For finding the density of weed, it can be counted manually.
- **Quadrat** of various sizes can be used randomly to count the weed species and find density, frequency, abundance.
- **Detection of *A. ludovaciana* using spectral differences**: *A. ludoviciana* can be distinguished from medicinal plants by analyzing their spectral signatures, particularly Red Reflectance (RR) and Normalized Difference Vegetation Index (NDVI). For instance, after 34 days of sowing, *A. ludoviciana* exhibits higher red reflectance and lower NDVI values than wheat due to its lower chlorophyll content and vigour. Infrared reflectance (IR) is also reported to peaks at 95 days after sowing with wheat showing higher values due to its denser canopy (Kaur et al., 2010). Similar techniques can be used to distinguish *A. ludovaciana* from the medicinal plants in the cultivated field.

Habitat

A. ludovaciana is found from tropical to temperate climate due to its wide adaptability traits. It require a specific dormant period which is mostly in summer. The weed is mostly present in terrestrial environment such as agricultural land, forests, orchards and other areas. Dry wasteland, cultivated ground and meadows, especially on heavier soils [https://pfaf.org/user/]. It can be present up to the altitude of 2600 m (CABI, 2022). It is mostly found in the field of winter crops like wheat and *Brassica napus* (CABI, 2022). Also, it has been reported in Nepal in crops like tea in Illam (Dangol et al., 2015) and orchards of Upper Manang (Sharma, 2010).

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Vector

It is a host of the following diseases and pest. (CABI, 2022)

- *Fusarium oxysporum* (basal rot)
- *Haplothrips tritici* (wheat thrips)
- *Rhipidothrips gratiosus*
- *Sclerotinia sclerotiorum* (cottony soft rot)

Survey method

Transect Walk Method

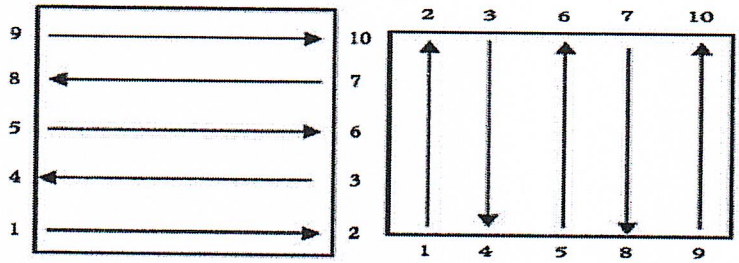

Fig. 2: Different transect walking method patterns that can be carried out during survey
Source: (Britton et al., 2014)

Transect walking involves selecting the survey area and establishing straight line or transects. The sampling plants are observed at constant intervals along these lines (For example, 5–10 meters). This method is also useful in forested or sloppy and uneven terrains where variation in vegetation is significant. While conducting the survey, surveyors should walk along the transect line and record the occurrence of *A. ludoviciana* in the observation points. This method is very effective for detecting species in large heterogeneous areas because it systematically covers variations of vegetation like forest areas (Kent, 2012).
Detection method (Section 6) visual observation and quadrant will be employed as per necessary.

Materials required

- Snake-proof boots, pants, and gloves
- Mosquito repellent
- First-aid kit (including antiseptic, anti-allergy tablets, rehydration sachets)
- Drinking water and food supplies
- Field notebook and waterproof paper
- Water-proof/alcohol-proof pens
- Field data recording formats
- Diagnostic keys (for weed identification)
- Mobile phone with SIM card and GPS functionality

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- Hand-held GPS unit
- Plastic and paper bags (for collecting samples)
- Specimen tubes with 70–90% ethanol (for preservation)
- Tissue paper and para film (to secure and wrap samples)
- Tweezers/forceps/scalpel (for delicate handling)
- Secateurs or pruning tools (for cutting weed samples)
- Trowel, spade, or small buckets (for uprooting plants with intact soil)
- Random number table or dice (for sampling points)
- Spray bottle with water (to keep samples fresh)
- Maps of the area
- Compass
- Measuring tape
- Brightly colored ribbons or tape (to mark sample sites)
- Zip-lock bags of various sizes
- Portable icebox (to keep samples cool)
- Herbarium press or sturdy plant press (with newspaper for drying specimens)
- Envelopes (for dried plant parts or seeds)
- Disinfectant wipes (for cleanliness)
- Pen-knife
- Envelopes /small vials for seed
- Altimeter
- Note book
- GPS

Performing the survey

The survey team should be equipped with all necessary plans, information, and tools to conduct the survey efficiently.

Collection and preservation of specimens

According to NPPO-Nepal (2024), following this need to be considered for collection and preservation of weed specimen.

- **Selection of weed specimens**

  - Vigorous and healthy weed specimens should be selected, avoiding plants with visible pest or disease damage.
  - Sufficient material should be collected to adequately fill a herbarium sheet (450 × 300 mm), leaving space for labeling. Larger plants should be divided and pressed across multiple sheets.
  - Key plant parts, including mature and juvenile leaves, buds, flowers, fruits, and bark, should be included whenever possible.

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- Specific protocols for various plant types, such as grasses, vines, and bulbs, should be followed to ensure proper sample collection.

- **Pressing and preserving specimens**

- Collected specimens should be pressed promptly. If immediate pressing is not feasible, they should be stored in plastic bags with damp paper and kept in a cool environment.
- Each specimen should be labeled with numbered tags and placed in folded newspapers within the press.
- Pressure should be applied evenly, and specimens should be dried in a warm place, with regular checks to replace damp newspapers and prevent mold.
- Delicate plant parts should be protected during handling and pressing by using tissue paper.

- **Mounting**

- Pressing and preserving specimens the dried specimens are mounted on herbarium sheets of standard size. Mounting is done with die help of glue, adhesive or cello-tape.

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Source: https://www.bing.com/images/

- **Labeling the specimens(**
  - Temporary field labels should be prepared for each specimen, which include:
  - The scientific name of the weed
  - Plant parts included in the sample
  - Collection locality, with coordinates or location codes
  - Date of collection and collector's name
  - Labels should be written with waterproof or alcohol-proof inks. For specimens stored in jars or slides, labels should be affixed directly to the container or slide.

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- **Label attached on herbarium sheet**

HERBARIUM	
11 aa	
Serial no. :	Family:
bb	cc
Latin name	Common name
dd	ee
Local name	Location
ff	gg
Date of collection	Collected by
hh	ii
Identified by	Verified by
Remarks: .....habitat, use , association Map; altitude, longitude ,latitude	

A map based on GPS data would be useful to visualize the distribution of *Avena ludoviciana* (Ranjit et al., 2006).

- **Submission for identification**
  - Diagnostic laboratories should be consulted for specific guidelines on the required condition of specimens and submission formats.
  - Detailed records should accompany each specimen, ensuring compliance with laboratory protocols and providing all necessary information for accurate analysis.

Analyzing data

- After completing the survey, the collected data should be analyzed to calculate essential statistics, such as average and total pest numbers.
- A map illustrating pest distribution or spread should be created based on survey data.
- Pest records should be compiled in a standardized format (as provided in Annex 3), listing pests associated with the surveyed hosts in the area.

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Reporting results

- The National Plant Protection Organization – Nepal (NPPO-Nepal) should be provided with both digital and hard copies of the final report for acceptance.

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Annexes

Annex 1: General information

Title of the study/survey	
Name of field/site visited	
Date/time of field visit when the pest was intercepted	
Name and the address of local people involved	
Contact details of local people/s involved in the survey	Phone: Email:
GPS reference point	Latitude:
	Longitude:
	Altitude:
Locality	Village name ward no.:
	Local level:
	District:
Climate data of locality	Average min. temp (in °C):
	Average max. temp (in °C):
	Rainfall (in mm):

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Annex 2: Details needed to be recorded in the field

Weed species identified	Growth Stage	Weed Density (per m^2)	Weed Habitat	Treatment (Yes or no)	Remarks

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