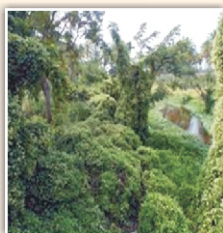


Weed survey and surveillance

The Directorate conducted survey and surveillance for collecting information on the spread and occurrence of weeds, and identified those causing serious problem.

- *Mikania micrantha* Kunth (Mile-a-Minute or Bitter vine), a problematic weed in north-east India, is rapidly spreading in Odisha and hilly terrain of Karnataka.
- Infestation of *Malwa parviflora*, *Rumex retroflexus*, *Poa annua*, *Coronopus didymus* and *Polypogon monspeliensis* is increasing in rice-wheat cropping zone.
- *Ipomoea*, a serious weed of sugarcane in Haryana and Uttar Pradesh, is getting established in southern parts of the country.
- *Phragmites karka*, a submerged and emergent weed, is spreading across Chilka lagoon and posing serious problem.
- *Parthenium* is spreading beyond the non-cropped areas, and gradually entering into cropped and plantation areas.
- Several species of weedy rice are spreading very fast and becoming nuisance in cultivated rice fields across the country.



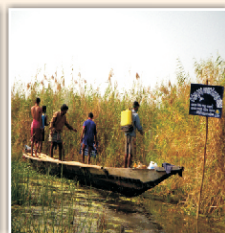
Mikania micrantha
infestation in
plantations



Weedy rice
infestation in rice



Ipomoea lacunose
infestation in
sugarcane



Phragmites karka
infestation in
Chilka lake

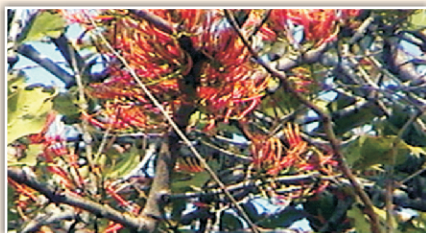
- *Phalaris minor*, a major problem of wheat, is also showing tolerance to clodinafop and sulfosulfuron, the major herbicides introduced to tackle its resistance to isoproturon in Punjab and Haryana.
- *Loranthus* (*Dendrophthoe* spp.), a parasitic weed, is infesting tea, fruit trees, viz. mango, sapota, guava, elephant-fruit, *jamun* (Blackberry), citrus, *ber* (Indian plum), etc., and other plantations like *sheesham* (Indian Rosewood), *mahua* (Indian Butter tree), *peepal* (Sacred Fig), *neem* (Indian Lilac), etc.



- A new problematic weed *Ambrosia psilostachya* has been observed in Muniyuru Bevinahally, Turuvekere Taluk, Tumkur District of Karnataka in waste lands, road sides, plantations, cultivated crops and forest shrubs.



Ambrosia psilostachya infestation

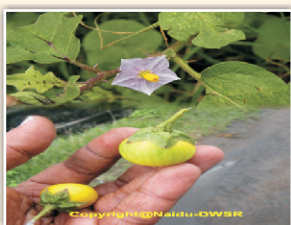


Loranthus infestation in plantation crops

- A new alien invasive weed, *Solanum carolinense*, has been detected in few locations of Andhra Pradesh, Tamil Nadu, Karnataka and Kerala.



Robust plant



Flower and fruit
Solanum carolinense



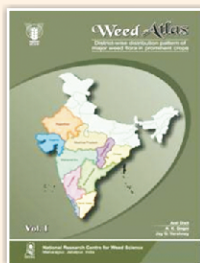
Cross-section of fruit

National database on weeds

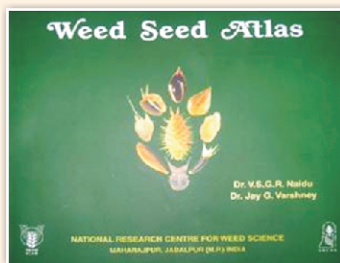
- Developed 2 volumes of Weed Atlas covering the dominant crop-field weeds of 435 districts and 19 states of the country.
- Developed a Weed Seed Atlas.
- Developed a weed seed repository of 100 species.



Weed Atlas (Vol-1)



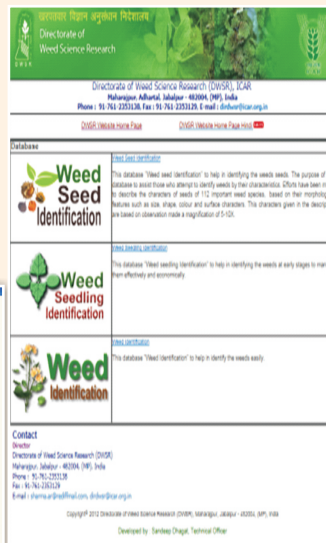
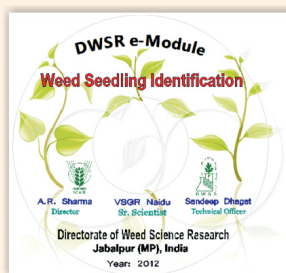
Weed Atlas (Vol-2)



Weed Seed Atlas

DWSR e-modules

Developed e-modules on identification of weed seeds, weed seedling and weed plants. These modules are very useful for effective and economic management of weeds. All these modules are uploaded on the Directorate website for end users.



Online databases for identification of weed seeds, seedlings and matured plants

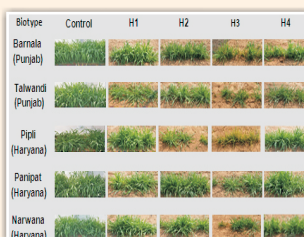
Weed biology and physiology

- Conclusively proved the presence of high morphological diversity amongst the *Echinochloa* germplasm of the country, and so far identified 15 taxa of species and intra-specific ranks under 11 species.
- Characterized about 100 weedy rice accessions for diversity with respect to morphological, physiological, biochemical and reproductive characteristics, dormancy and shattering pattern.
- Recorded weed suppressing ability of a quick-growing and spreading type pea cultivar 'JP 885'.
- Elucidated biology of *Parthenium hysterophorus*, *Alternanthera sessilis*, *Cassia tora*, *Celosia argentea* and *Bracharia eruciformis*.
- Developed technology to break the seed dormancy of wild oat, *Ageratum houstonianum*, *Bidens pilosa*, *Mimosa pudica* and *Cyperus iria* using Ga_3 .
- Observed multiple herbicide resistance in *Phalaris minor* biotypes from Haryana and Punjab.





Diversity in weedy rice accessions



Multiple herbicide resistance in *Phalaris minor* biotypes

H1: IPU
H2: Pinoxaden
H3: Mesosulfuron-methyl + iodosulfuron-methyl-sodium
H4: Sulfosulfuron + metsulfuron-methyl

- **Global climate change**
- Studied the possible effect of climate change on crop-weed competition and herbicide efficacy. Predicted increasing competitive ability of *Phalaris minor* compared to wheat and wild oat due to global warming.
- Observed reduced efficacy of sulfosulfuron against *Phalaris minor* under elevated temperature and CO₂, making management of this weed more difficult.



Wheat Wild oat *Phalaris minor*
Effect of elevated CO₂ and temperature



Ambient CO₂ & temp. Elevated CO₂ & temp.
Efficacy of sulfosulfuron on *Phalaris minor*

Weed management in crops and cropping systems

- Made herbicide recommendations for various crops and cropping systems based on the multi-disciplinary and multi-location trials conducted in different agro-climatic zones.
- Recommended alternative chemical weed control methods to counter weed flora shift caused by continuous use of some herbicides.
- Developed weed management technologies for conservation agriculture systems.



Zero-till rice



Zero-till maize



Zero-till wheat



Zero-till mustard



Zero-till chickpea



Zero-till greengram

Weed management in different crops under conservation agriculture systems

- Monitored herbicide residues in soil, water and food chain under several crops and cropping systems across the country. When used at recommended rates, the herbicide residues were within the safety limit in soil and edible plant parts.
- Studied the impact of herbicides on soil micro-flora. In general, recorded short-term and reversible adverse effects of herbicides on soil microbial population.
- Noticed reduction in *Phalaris minor* but increase in wild oat population in ZT-wheat under rice-wheat system.
- Recorded weed shift from grassy to broadleaved species, especially *Euphorbia geniculata*, under continuous use of fenoxaprop in soybean.



Untreated



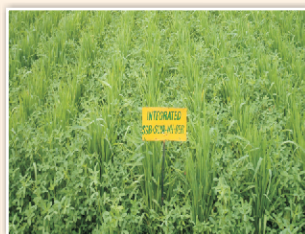
Fenoxaprop-treated

Soybean

- Developed IWM technologies using cowpea, *Sesbania* and berseem as intercrops in maize, rice and wheat, respectively.
- Developed IWM technologies for new orchards using cover crops.
- Developed non-chemical methods of controlling annual weeds in sesame-tomato system by integrating soil solarisation technique and FYM application.
- Developed technique for weed management in vegetable crops using black polythene mulch.



Managing weeds in rice through *Sesbania* brown manuring



Berseem as intercrop in wheat



Cowpea as cover crop
in citrus orchard



Soil solarization
for vegetable nursery



Black polythene mulch
in okra

Mechanical tools

- Improved several weeding tools from different parts of the country for more efficient weeding.
- Developed a wick applicator for application of non-selective herbicides in standing crops like mustard and soybean.



Wick applicator
in soybean



Directed spray
in mustard

Management of problem weeds

- Summer ploughing *fb* glyphosate application (2.0 kg/ha) at 4-6 leaf stage during April-May was found effective in controlling *Saccharum spontaneum* (Kans).
- Quizalofop at 125-150 g/ha was also found effective in managing *Saccharum spontaneum* in mustard, chickpea and pea.
- Metsulfuron-methyl was found effective in controlling alligator weed (*Alternanthera philoxeroides*) in aquatic bodies and lowland areas.



Saccharum in untreated and glyphosate-treated fields



Alligator weed infested pond

- स Managed *Asphodelus tenuifolius* in chickpea using oxadiazon (0.5 kg/ha) and pendimethalin (1.0 kg/ha) as pre-emergence.
- स Managed the problem of *Cuscuta* in niger and blackgram using pendimethalin (1.0 kg/ha) as pre-emergence.
- स Soil solarisation and application of neem cake were found promising for managing *Orobanche* in tobacco, potato, tomato, mustard etc.
- स Post-emergence spraying of 2,4-D (0.6%) + urea (2%) was found effective in managing the root parasite *Striga asiatica* in sugarcane.



Orobanche in tomato and tobacco



Cuscuta in onion



Striga asiatica in sugarcane

Weed utilization

- Utilized *Parthenium* and water hyacinth biomass for making compost/vermi-compost with nutrient contents equivalent to FYM.
- Utilized *Parthenium* biomass for making paper and particle boards.



Particle board made
of *Parthenium*



Paper made
of *Parthenium*



Vermi-composting unit

- Evaluated the biomass of several weed species like *Lantana*, *Mikania*, *Chromolaena*, *Ipomoea carnea*, *Salvinia*, water hyacinth etc. as effective mulch materials.
- Evaluated *Arundo donax* for phytoremediation of nickel, copper, nitrate and phosphate contaminated waste water.



Water hyacinth mulch in potato



Arundo donax grown in hydroponics

Biological control of weeds

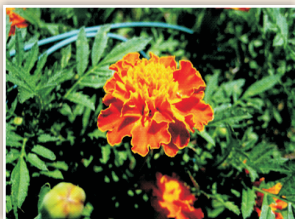
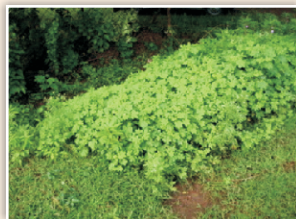
- Developed technique for mass multiplication of Mexican beetle (*Zygogramma bicolorata*), an effective bioagent against *Parthenium hysterophorus*.
- Identified environmentally beneficial competitive plants, viz. *Cassia* and marigold to suppress *Parthenium* growth.



Mexican beetle feeding on *Parthenium*



Parthenium infested non-crop land



Cassia tora and marigold suppress *Parthenium*

- Successfully suppressed water hyacinth in three ponds of Jabalpur using *Neochetina* sp., an exotic bioagent.



A pond full of water hyacinth



Adult *Neochetina* feeding on leaves

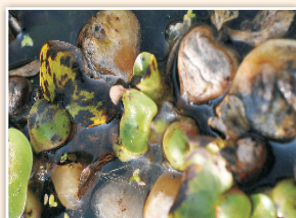


Browning of water hyacinth due to *Neochetina* attack

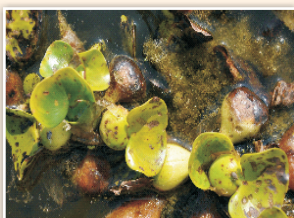
- Isolated a new rust bioagent, *Puccinia* sp. (isolate NRCWSR-3), to manage *Lagascea mollis*, an exotic weed.
- Isolated and evaluated the promising strains of *Alternaria alternata* and *A. eichhorniae* as bioagents to manage water hyacinth.



Reduced growth of *Lagascea mollis* due to *Puccinia* sp.



Alternaria alternata infected water hyacinth



Alternaria eichhorniae infected water hyacinth