Wetland weeds and their management

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A weed is generally considered to be a plant that grows where it is not wanted. Or it is an unwanted and undesirable plant species in a particular locality. A better definition is that it is a plant that has the capacity to invade cultivated or disturbed land or natural ecosystems. Weeds are generally vigorous and hardy and successfully compete with native species for space, light, nutrients and water. This is not because native species are inherently weak, but rather because, unlike native species, the weeds have left their disease organisms and grazing animals behind in their natural environment. Every crop is exposed to severe competition from weeds. Most of these weeds are self-sown and they provide competition caused by their faster rate of growth in the initial stages of crop growth. In some crops, the yields are reduced by more than 50% due to weed infestation.

Weed seeds are dispersed by a range of mechanisms which includes transportation by wind and water and consumption of weeds and their fruit by native or introduced animals. Native birds are a good example of a most effective "vector" for dispersal. Weed invasion threatens wetland biodiversity, leading to a decline in both species and habitat diversity. Weeds impact upon wetland ecology in a number of ways by:

- ❖ Directly competing with established native wetland plant communities;
- ❖ Restricting native plant regeneration through competition; and
- ❖ Reducing the resources available for feeding, breeding and shelter of fauna;

Aquatic weeds have the potential to threaten irrigation channels and to block waterways. They can spread rapidly and form dense mats above or below the water. These results in a reduction in light entering the wetland and depletion in oxygen levels in some cases causing death of aquatic fauna such as fish.

Wetland weeds

The weeds that are common in a rice eco-system are normally considered as wetland weeds. Rice crop suffers from various biotic and abiotic production constraints. Among them, the weed competition is one of the prime yield limiting biotic constraints in rice. Weeds compete with crops for water, light, nutrients and space. Weeds are the most competitive in their early growth stages than at later stages and hence the crop growth is affected and finally grain yield decreases (Jacob and Syriac, 2005). Barua *et al.* (2008) reported that, the critical period of crop weed competition in transplanted rice as 30 to 60 days after transplanting. Ghosh (2010) observed that 3-4 weeks after transplanting was the critical crop weed competition.

Some of the common characters of wetland weeds are:

a. Adapted to waterlogged condition
b. Anaerobic condition favours most of the wetland weeds

c. Weeds are lustrous having lower requirement for light and oxygen than dryland weeds

d. Mostly annuals under crop situation and perennials are on the channels and bunds

e. Most of the weeds are heavy seed producers

f. Some weeds posses floating mechanism in stem or leaves

g. Most weeds bound to occur seasonally

Weeds commonly observed under wetland conditions

Scientific name	Family	Common name
Grasses		
Echinochloa colona	Poaceae	Jungle Rice
Echinochloa crus-gulli	Poaceae	Barnyard grass
Echinochloa glabresence	Poaceae	
Brachiaria mutica	Poaceae	Para grass
Cynodon dactylon	Poaceae	Bermuda grass
Paspalum distichum	Poaceae	
Chloris barbata	Poaceae	Myil kondai pul
Sporobolus spp.	Poaceae	
Panicum spp	Poaceae	Guinea grass
Broad-leaved		
Eclipta prosterata	Asteraceae	Karisalanganni
Ludwigia parviflora	Onagraceae	Neercrambu
Rotala densiflora	Lythraceae	
Ammania baccifera	Lythraceae	Blistering Ammania, Kalluruvi, Neermel nerruppu

Hygrophilla auriculata *Syn: Astercantha longiflolia*	Acanthaceae	Neermuli
Centelella asiatica	Umbelliferae	Indian Pennywort
Phyla nodiflora *Syn: Lippia nodiflora*	Verbanaceae	Poduthalai
Nastrutium indicum	Cruciferae	Kattu-kadugu
Monochoria vaginalis	Pontederiaceae	Neer thamarai
Eichhornia crassipes	Pontederiaceae	Agayathamarai
Sphaeranthus indicus	Asteraceae	Kottai-karanthai.
Commelina benghalensis	Commelinaceae	Kanankeerai, Day flower
Cyanotis axillaris	Commelinaceae	Neer-pulli
Ruellia tuberose	Acnathaceae	Pattasukai
Sonchus arvensis	Asteraceae	Common Sow Thistle
Sonchus oleraceous	Asteraceae	Common Sow Thistle
Marselia quadrifoliata	Marsiliaceae	The Water Fern, Arai Keerai
Sedges		
Fimbristylis milliacea	Cyperaceae	Poonkorai, kalaikolarangu
Cyperus difformis	Cyperaceae	Vatta korai
Cyperus iria	Cyperaceae	Oosi korai
Scirpus sp.	Cyperaceae	

Management of Wetland Weeds

Cultural Methods:

Several cultural practices like tillage, planting, fertiliser application, irrigation etc., are employed for creating favourable condition for the crop. Cultural methods, alone cannot control weeds, but help in reducing weed population. They should, therefore, be used in combination with other methods. In cultural methods, tillage, fertiliser application and irrigation are important. In addition, aspects like selection of variety, time of sowing, cropping system, cleanliness of the farm etc., are also useful in controlling weeds in rice eco systems.

1. Field preparation: The field has to be kept weed free. Flowering of weeds should not be allowed. This helps in prevention of build up of weed seed population.

2. Summer tillage: The practice of summer tillage or off-season tillage is one of the effective cultural methods to check the growth of perennial weed population in crop cultivation. Initial tillage before cropping should encourage clod formation. These clods, which have the weed propagules, upon drying desiccate the same. Subsequent tillage operations should break the clods into small units to further expose the shriveled weeds to the hot sun.

3. Maintenance of optimum plant population: Lack of adequate plant population is prone to heavy weed infestation, which becomes, difficult to control later. Therefore practices like selection of proper seed, right method of sowing, adequate seed rate protection of seed from soil borne pests and diseases etc. are very important to obtain proper and uniform crop stand capable of offering competition to the weeds.

4. Crop rotation: The possibility of a certain weed species or group of species occurring is greater if the same crop is grown year after year. In many instances, crop rotation can eliminate atleast reduce difficult weed problems. The mimicry weeds like *Echinocloa colonum and Echinocloa crusgulli* can be controlled effectively in crop rotation.

5. Growing of intercrops: Inter cropping suppresses weeds better than sole cropping and thus provides an opportunity to utilize crops themselves as tools of weed management. Green manure crop like Sesbania effectively smother weeds without causing reduction in the yield of main crop.

6. Stale seedbed: A stale seedbed is one where initial one or two flushes of weeds are destroyed before planting of a crop. This is achieved by soaking a well prepared field with either irrigation or rain and allowing the weeds to germinate. At this stage a shallow tillage or non- residual herbicide like paraquat may be used to destroy the dense flush of young weed seedlings. This may be followed immediately by sowing. This technique allows the crop to germinate in almost weed-free environment. This method is one of the best one in controlling weedy rice

10. Crop management practices: Good crop management practices that play an important role in weed control are

a. Vigorous and fast growing crop varieties are better competitors with weeds.
b. Proper placement of fertilizers ensures greater availability of nutrients to crop plants, thus keeping the weeds at a disadvantage.
c. Better irrigation practices to have a good head start over the weeds
d. Proper crop rotation programme
e. Higher plant population per unit area results in smothering effect on weed growth

Sl. No	Herbicide Name	Trade Name	Formulation	PE/POE	Spectrum
1.	Alachlor 2 kg a.i ha^{-1}	Lasso	50% EC	Pre emergence	Grasses and BLW
2.	Anilofos 0.4 kg a.i ha^{-1}	Aniloguard	30% EC	Pre emergence	Annual grasses and sedges, selected BLW
3.	Butachlor 1.0 kg a.i ha^{-1}	Machete Hilaklor	50% EC 50% EC	Pre emergence	Annual grasses and BLW
4.	Pretilachlor 1 kg a.i ha^{-1}	Sofit Rifit	30.7% EC 50% EC	Pre emergence	Annual grasses and BLW
5.	Pyrazosulfuron ethyl 20 g a.i ha^{-1}	Saathi	10% WP	Pre emergence	Annual BLW and perennial sedges
6.	Oxadiargyl 100 g a.i ha^{-1}	Topstar	70% WG	Pre emergence	Annual Mono-cotyledon and dicotyledon
7.	Bensulfuron methyl +	Londax	60% WG	Post	BLW and sedges
	pretialchlor 10 kg a.i ha^{-1}	power		emergence	
8.	2, 4 - D sodium salt 1.0 kg a.i ha^{-1}	Fernoxone	80 % WP	Post emergence	BLW
9.	Bispyribac - Sodium 25 g a.i ha^{-1}	Nominee Gold	10% SC	Post emergence	Grasses, sedges and BLW
10.	Ethoxysulfuron 18.75 g a.i ha^{-1}	Sunrice	15% WDG	Post emergence	BLW and sedges
11.	Chlorimuron ethyl 15 g a.i ac^{-1}	Kloben	25% WP	Post emergence	BLW
12.	Metsulfuron Methyl 8 g a.i ac^{-1}	Algrip	20% WP	Post emergence	BLW and grasses

Mechanical weeding:

Single, Double row rotary weeders, Cono weeder, Power operated rotary weeders are used in controlling weeds in different rice eco systems.

Herbicidal Weed Management

The following herbicides are recommended for rice crop at different stage of crop growth for effective control of weeds

Recommended Integrated Weed Management practices in Rice

Creative application of agronomic, mechanical biological and chemical methods usually referred to as integrated weed management.

Nursery

Butachlor 2.0 l/ha (or) Pendimethalin 2.5 l/ha (or) Anilophos 1.25 l/ha. Herbicides should be applied on 8 DAS with thin layer of water in the field.

Transplanted rice

Pre emergence

- Pre-emergence (PE) application of pretilachor at 1.0 kg a.i. ha^{-1} on 3 DAT + Twin row rotary weeder weeding at 40 DAT
- PE Pyrazosulfuron ethyl 10 % WP @ 150 g ha^{-1} on 3 DAT + hand weeding (HW) on 45 DAT.
- PE butachlor 0.75 kg a.i. ha^{-1} + bensulfuron methyl 50 g ha^{-1} on 3 DAT + HW on 45 DAT
- PE Oxadiazon 87.5 g a.i. ha^{-1} followed by Post emergence (POE) 2,4-D 1 kg a.i. ha^{-1} along with hand weeding on 35 DAT.
- PE butachlor 0.75 kg per hectare + bensulfuron methyl 50 g ha^{-1} on 3 DAT followed by mechanical weeding on 45 DAT is effective for broad spectrum weed control.
- Crop growth and yield were enhanced by butachlor 1.2 + 2,4-DEE 1.5 lit ha^{-1} with 100% inorganic nitrogen.
- Conventional tillage of one dry ploughing and two passes of cage wheel puddling combined with pre-emergence application of butachlor at 1.25 kg ha^{-1} under lowland situation.
- Stale bed preparation by pre-puddling minimum tillage with glyphosate combine with post-plant pre emergence butachlor 1.25 kg ha^{-1} resulted in increased rice grain yield, net income and B: C ratio in rice-rice cropping.

Post emergence

- Early post emergence application of Bispyripac sodium 50 g a.i. ha^{-1} (2-3 leaf stage of weeds) + Hand weeding on 45 DAT

Wet seeded rice

- Hand weeding twice on 15 - 20 DAT and 45 DAT will control the weeds effectively (or) with optimum moisture condition Pendimethalin 3.0 llit at 8 DAT and one hand weeding on 45 DAT.
- Productivity and economic returns of wet seeded rice with dual cropping of danicha could be maximized by the pre-emergence application of pretilachlor + safner at 0.45 kg ha^{-1} followed by one cono weeder in between rows and manual weeding with the rice rows on 35 DAS in lowland conditions.
- PE pretilachlor + safner 0.45 kg ha^{-1} on 3 DAS + roto cylindrical weeder weeding on 45 DAS in wet seeded rice resulted in excellent control of weeds like *Echinochloa crusgalli*, *Panicum repens*, *Eclipta alba* and *Monochoria vaginalis* and higher grain yield, net monetary return and B:C ratio.
- PE pretilachlor (S) 0.45 kg ha^{-1} on 3 DAS fb azimsulfuron 50 DF 35 g ha^{-1} on 20 DAS + hand weeding on 45 DAS (T_2) for broad spectrum weed control and higher grain yield and economic returns in both irrigated and rainfed direct seeded rice.
- Higher productivity of wet direct seeded (drum seeded) rice could be achieved by integrating intercropping of daincha and pre-emergence application of pretilachlor + safner at 0.45 kg ha^{-1} on 4 DAS followed by one hand weeding on 35 DAS.

- Rice -Rice -Fallow system intercropping of *Sesbania rostrata* control the weeds of rice field along with incorporation of *Sesbania rostrata* in to the field and one hand weeding on 35 DAT.

SRI - System of Rice Intensification

- Power operated two row weeder is recommended for SRI cultivation.

Semidry rice

- PE butachlor 1.0 kg ha^{-1} followed by weeding using finger type single row and double row rotary weeders resulted in higher grain yield and net profit.

Rainfed Rice

- Seed drill sowing with pre-emergence application of pretilachlor + safener @ 0.3 kg/ha followed by two weedings with star / rotary weeder is recommended.

Aerobic rice

- Higher crop yield and B:C ratio were obtained with PE pendimethalin 1.0 kg ha^{-1} along with single tyne sweep weeding on 45 DAS which was comparable with PE along with hand weeding.

Sugarcane:

- Spray Atrazine 2 kg or Oxyflurofen 750 ml/ha mixed in 600 liters of water as pre emergence herbicide on the 3rd day of planting, using deflector or fan type nozzle fitted with knapsack sprayer.
- The pre emergence application of atrazine @ 1.0 kg a.i. ha-1 on 3 DAP followed by post emergence directed application of glyphosate @ 1.0 lit ha-1on 45 DAP with hood+ one hand weeding on 90 DAP registered the maximum cane yield.

- If pre-emergence spray is not carried out, go in for post-emergence spray of Grammaxone 2.5 litre + 2,4-D sodium salt 2.5 kg/ha in 600 liter of water on 21st day of planting.
- If the parasitic weed striga is a problem, post-emergence application of 2,4-D sodium salt @ 1.25 kg/ha in 500 litre of water/ha may be done. 2, 4-D spraying should be avoided when neighbouring crop is cotton or bhendi. Apply 20% urea also for the control of striga as direct spray.
- Control of creeper weeds post emergence directed application of fernoxone (2, 4 –D sodium salt) @ 2 gm + 10 gm of urea per liter of water may be sprayed over the creeper weeds.

Weed management in Sugarcane intercropping system

- Premergence application of Thiobencarb @ 1.25 kg ai/ha under intercropping system in Sugarcane with Soybean, blackgram or groundnut

Weedy Rice

Weedy rice (also called red rice in the Americas), with its populations of annual Oryza species, has been recognized as one of the most problematic weed species in rice production systems. Because of the morphological and physiological similarities of weedy rice to cultivated rice and the absence of standing water at the time of crop emergence, the adoption of direct-seeded rice systems in Asia makes weedy rice infestation one of the most serious problems that farmers encounter. Weedy rice is thought to be the result of hybridization between cultivars or crossing between cultivars and wild rice, or a result of segregation from landraces (Bhagirath Singh Chauhan. 2013).

In Tamil Nadu, the infestation of weedy rice is noticed in Anamalai, Coimbatore District, Trichy District and some parts of southern districts. By infesting rice fields, weedy rice increases production costs and reduces farmers' income by decreasing yield. Weedy rice can cause rice yield loss by 50–60% under moderate infestation (15–20 weedy rice panicles m^2), 70–80% under high infestation (21–30 panicles m^2), and total yield loss under heavy infestation as this may cause lodging in rice plants.

Management strategies

- Use of certified seeds
- Clean farm implements before entering them in a field
- A stale seedbed helps reduce the weed seed bank and weed density in the crop
- Use of high seeding rate
- Preplant application of rice selective herbicides will control weedy rice some extent
- Crop rotation allows in distrupting the growth cycle of weedy rice

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