A REVIEW

ADVANCE RESEARCH JOURNAL OF
C R O P
IMPROVEMENT
Volume 7 | Issue 1 | June, 2016 | 176-179
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/7.1/176-179
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Resource conservation technology for weed management

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ABSTRACT : Weeds reduce crop yields and can lead to total crop failures if not controlled. Weeds continue to be an important constraint in crop production. Despite the best efforts made in research and extension in the field of weed science, the farmers continue to experience heavy losses in crop yield due to weed interference. A conservative estimate of about 10 per cent loss would amount to a loss of about 25 million tonnes of food grains, currently valued at approximately USD 13 billion. Losses of similar fashion may occur in plantation crops, fruits, vegetables, grass lands, forestry and aquatic environment. The total economic losses will be much higher, if indirect effect of weeds on health, loss of biodiversity, nutrient depletion, grain quality etc is taken into consideration.

KEY **W**ORDS : Weed, Management, Resource conservation

How to cite this paper : Kumar, Amrendra, Kumar, Sunil and Kamat, D.N. (2016). Resource conservation technology for weed management. *Adv. Res. J. Crop Improv.*, **7** (1) : 176-179, **DOI : 10.15740/HAS/ARJCI/7.1/176-179**.

Paper **H**istory : **Received :** 31.12.2015; **Accepted :** 30.05.2016

Weed managed through conventional method is highly expensive, so for efficient management of labour, water, energy which are vital resource needs to be utilized in a better way for sustainable production. Presently weeds are managed by application of herbicide but in same time some big problem have emerged such as evolution of resistant weed biotypes, prepondence of perennial weeds, shifting of weed flora, residue hazards and pollution to the ecosystem, therefore, resource conservation technology for weed control may be a good option for managing weeds. Resource conservation technology refers to any management approach of technology that increases factor productivity including land, labour, capital and inputs. It includes wide range of practices including zero tillage, minimum tillage, mulching, crop residue, drip irrigation, sprinkler irrigation. Jat *et al.* (2003) concluded that total number of weeds in wheat was observed less under laser leveled field as comparison to traditional leveled, this was due to laser leveling results in uniform moisture distribution to the entire field and allows uniform crop stand and growth, thus, resulting in lesser weed infestation.

Weed management through crop establishment methods / tillage (zero tillage, FIRBS, ridge and furrow) :

Conventional tillage clean the field without any plant debris but during this erosion of soil takes place. It is energy consuming costly operation, rapid decomposition of soil organic matter. Apart from this repeated use of heavy machinery destroy soil structure, causes soil detoriation and leads to erosion. Therefore, conservation tillage such as zero/ minimum tillage play a great role for checking and conserving soil erosion, soil organic matter, moisture.

Zero tillage helps in early sowing, save water, labour, increase fertilizer use efficiency and improve soil organic carbon. Retention of crop residue helps in improving soil organic matter, soil structure and microbial population. Bed planting promotes crop diversification; obviate water logging stress *in situ*, rain water conservation, less lodging bolder grain. FIRBS save the cost of operation, seed (25%), fertilizer (25%), irrigation water (35%) less weed population. the use of beds also provides a way for improving fertilizer use efficiency. Mollah *et al.* (2009) observed the effect of planting method on weed density and grain yield of wheat. They took two treatment bed planting and CT. and observed that weed population and dry wt. is lower in narrow bed *i.e.* 70 cm in 3 rows is mainly due to the closer spacing of wheat crops. With the increase of the bed width with 70-80-90 cm yield were decreases due to less panicle per metre, grain per panicle and test weight. The number of grains/panicle was significantly higher in two plants rows than 3 plant rows. The lower number of weeds in bed might be due to dry top surface of weeds in beds that inhibits the weed growth. At the time of bed preparation top soils of the furrows were mulched to the raised bed which drastically reduced the weeds in furrow. The total number of weeds saving by 70(45%), 80(48%), 90(80%), as compare to CT. Among the bed the narrow bed (70 cm) required slightly higher amount of irrigation than wider bed. The areas of furrow unit are in wider bed is lower than the narrow bed. So it receives lower amount of irrigation water by placing a band of fertilizer in the bed at planting or top dressing. Pandey *et al.* (2001) observed on effect of tillage on weed density, weed dry weight and yield of wheat and concluded that lower density and dry weight of weeds in rotavator plots as compared to ZT and CT (farmers practice), might be attributed to disturbance of only top soils layer, which have not allowed the seeds to germinate laying in the second layers. Sharma *et al*. (2004) observed the effect of tillage practices on weed and wheat productivity and they observed that. The dominant weeds in the experimental field were *Phalaris minor*. Although zero tillage produced lower *Phalaris minor* dry weight compared to other tillage options and the differences were marginal, the broadleaf weeds' infestation was highest in ZT. Among the broadleaf weeds, the population of *Rumex* was maximum (34500 plants/ ha) under ZT and minimum in CT and rotary tillage. The extent of yield reductions due to weeds was minimum in FIRBS and rotary tillage and maximum in ZT. The lower yield reduction in FIRBS was due to the presence of weeds mainly in the furrows owing to sufficient moisture and drier conditions on the bed. Therefore, crop and weed proximity was less and also the crop being on higher elevation (on bed) had an advantage of height, which is directly related to competitive ability in cereals. The yield reduction in ZT plots was due to more population of *Rumex* as evident from the population and dry weight of broadleaved weeds. The present study indicates that continuous ZT in wheat under rice–wheat sequence may lead to lower *Phalaris minor* incidence which would favour the buildup of broadleaved weeds, particularly the *Rumex* spp.

ZT-Zero tillage, CT-conventional tillage and FIRBS-furrow irrigated raised bed system :

Singh *et al*. (2005) observed effect of density and dry weight of grasses in rice under different cropping systems and reported that weed flora in rice changed due to change in cropping system. In rice-wheat system, relative density of sedges was 61 per cent and the grassy and non-grassy were 28.5 and 10.4 per cent, respectively. In sugarcane- rice cropping system, the relative density of sedges, grasses and non-grasses was 50.1,15.8 and 34.1 per cent, while in rice-pea-rice system, it was 36.4,28.0 and 35.6 per cent. Singh and Singh (2007) observed weeds population (25 DAS) was observed lower in ZT as compared to CT. This was due to less disturbance of soil where seed of wheat is sown with the help of zero till machine. In addition ZT also saved cost of production around 2200-2500/ha and a week advance in sowing during winter. Use of zero -cum-seed fertidrill in wheat sowing after harvest of paddy and supplemented with broad spectrum application of herbicide (Sulfosulfuron +MSM) were effectively controled weeds density along with more grain yield. Parmeswari and Srinivas (2010) studied on influence of crops establishment methods on weed management in rice and they observed that weed density and dry weight in transplanted rice is significantly lower than direct sown rice and at par with SRI (System of rice intesification). Grain yield was found greater to direct sown rice under puddle condition. Submerged condition in transplanted rice facilatetes availability of more nutrients by reducing leaching and keep the salt content under control which encourages tiller production and thus, contributing to higher dry matter production and grain yield.

Weed management by soil solarization and mulching:

Soil solarization is that light received from sun in the form of electromagnetic short wave which is easily pass through the transpansive colourless polythene films and reach to the soil as a result soil is heated and emits long wave terrestrial radiation which cannot pass through transparent polythene film and result in build up or trapping heat. Water droplet form on the inner surface, highly reduces the transmittance of transparent film to long wave terrestrial radiation and induced increased green house effect. Mulching is any material applied on the surface to check evaporation and improve soil water and reduce erosion. All most all mulch except polythene film is bad conductor of heat. They get heated up on receiving short-wave radiation but conduction of heat is almost negligible as a result weed germination are prevented due to lack of congenial temperature and sunlight. The lack of sunlight inhibits photosynthesis of the germinating weeds and causes them to die. Sahile *et al.* (2005) evaluate the effect of soil solarization on orobanche control in tomato fields. Clear and black polyethylene sheets were used to cover the soil and evaluated for their efficiency to transfer solar heat to the soil orobanche control. Soil temperature was raised from 32 to 48°C, 33 to 46°C and 37 to 49°C by covering with clear polythene sheet. The effect of soil solarization between clear and black polyethylene sheets were compared in reducing orobanche soil seed bank. The result showed that a control of orobanche was 97, 92 and 91 per cent for white sheet cover. Polyethylene sheets compared to uncovered soils. 650/854, 232/447 and 411-660. Mean yield of tomato was found high at 6 weeks due to lesser number of weed contributed significantly higher than check value and other treatments but at par with 8 weeks. The yield is high mainly due to a decrease in orbanchae shoot count and improved soil status and enhanced decomposition of soil during soil solarization. Kumar *et al.* (2005) observed the effect of wheat residue mulch and sesbania coculture on weed density and weed biomass 60 DAS after sowing and grain yield. Sesbania co culture/intercropping. has shown promise for suppressing weeds in ZT rice production involves sowing sesbania at 25 kg ha^{-1} along with rice. Sesbania is allowed to grow with rice to suppress weeds and is then killed with 2,4-D ester 25 to 30 d after sowing (DAS). Singh and Singh (2007) reported 76 to 83 per cent lower broadleaf densities and 20 to 33 per cent lower grass densities with this practice compared with only a rice crop. However, this practice may pose some risks, including competition of sesbania with rice if 2,4-D application is ineffective or its application is delayed because of continuous rain and (2) additional costs associated with sesbania seeds and management.

Weed management through nutrient :

Singh *et al.* (1999) observed the effect of straw burning and straw removal on the population, dry wt. and control of *Phalaris minor* and concluded weed population and dry wt. was found higher in straw burning as compared to check. Straw burning decreases weed population /efficiency because burning break the dormancy of phalaris seed and thus, germination stimulated. Ahuja and Yaduraju (1989) observed the effect of fertilizer application method on population of *Phalaris minor* and grain yield of wheat. They took two treatment broadcast and placed (2.5 cm below seed) and concluded that weed population of *Phalaris minor* was found significantly lower in placed as compared to broadcast. It might be due to when fertilizer is placed below 2.5 cm then fertilizer used by crop seed intensively and weed seed not take this fertilizer while in broadcasted the fertilizer is broadcasted uniformly over the unit area of field so upper layer of weed seed exhaust the nutrient. And population is high so grain yield is found significantly higher than broadcast.weed control by sub-surface drip irrigation. Subramanian *et al.* (2005 and 2007) and Subramanian and Martin (2006) evaluate the effect of nitrogen management on weed density, dry weight and yield of rice and they found that 100 per cent N+sesbania +azolla significantly reduces weed density as well as weed dry weight compared to other treatments specially 100 per cent N because azolla form thick mat which hindered light and air to weed. Similarly grain yield was found significantly higher in 100%N+sesbania +azolla but at par with 100%N+sesbania to other treatment.

Weed manage through irrigation :

Stephen *et al*. (1988) studed weed control by sub-surface drip irrigation in tomato. Three irrigation methods were selected: furrow, sprinkler and subsurface drip. The laterals of the drip system were buried in the plant row, 10 inches below the surface of the bed. Weed growth was studied in a field of processing tomatoes. This zone was monitored because it is generally considered to be the optimal depth for weed germination. In the case of furrow irrigation, the water content was greater and weed growth was more vigorous in the furrow than in the plant row. Although herbicides largely reduced weed growth, the relationship between soil water and weed growth was the same as in plots with no herbicide. Under sprinklers, the surface soil water content 24 hours after irrigation was uniform within the plot, yet more weeds were found in the furrow than in the bed. This result indicates that weed distribution under furrow and sprinkler irrigation is related not only to the surface soil water content but also to crop density. The total mass of weeds produced per surface area in fields irrigated by subsurface drip were several orders of magnitude less than were produced under the two other irrigation methods. In sprinkler and furrow-irrigated plots, there was no difference in weed growth between herbicide-treated and untreated subsurface drip plots.

The review study in this paper shows that for effective weed management strategies the following resource conservation technology may be adopted

– Laser leveling is necessary pre-requiste for effective weed management.
– Subsurface drip irrigation is an ecologically sound alternative for reducing weed population.
– Crop residue in form of mulch/soil solarization can play important role in reducing weed menance.
– Crop rotation and intercropping can be helpful in controlling effective weed management strategy.
– Many crop establishment methods alliniate to conventional generally have low weed pressure.

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