Journal of Chemical, Biological and Physical Sciences

An International Peer Review E-3 Journal of Sciences

*Available online at*www.jcbsc.org

Section B: Biological Sciences

CODEN (USA): JCBPAT Research Article

An overview on various weed control practices affecting crop yield

Shah Jahan Leghari[1*], Umed Ali Leghari[1], Ghulam Mustafa Laghari[1], Mahmooda Buriro[1], Farooque Ahmed Soomro

[1]Department of agronomy, Sindh Agriculture University Tandojam, 70060, District Hyderabad, Sindh, Pakistan

Received: 19 October 2015; **Revised:** 06 November 2015; **Accepted:** 12 November 2015

Abstract: Weeds are known as unwanted, undesirable, unsuitable and harmful plants. They are mostly C_4 plants (Extraordinary metabolize essential carbon) and have vigor growth. Due to vigorous growth and inordinate development, they compete with all type of crops including cereals, fiber, sugar, medicinal and vegetable crops as well as floricultural crops for nutrient, place, space, air, carbon dioxide (CO_2), water (H_2O), light, soil moisture and soil oxygen etc that result in causes of long or short stressful periods during growth and development of plant which have adverse influence on the harvest and straightforwardly diminish the yield and quality of crops. Various methods are utilized to control the weeds but all methods are not efficient equally against weeds before they give any damage to the harvests, with the exception of a few. These involves use of weedicides, hoeing, tillage operations, hand pulling, pure seed, seeding rate, mulching, Intercropping, cultivation of weed competitive varieties, mixed cropping, sowing time, sowing methods and use of fertilizer practices. However nowadays modern agriculture concept is giving recommendation to use all these practices combined which is known as integrated weed management (IWM). This review paper evaluates different weed management practices in different crops and suggests effective weed control methods for good crop yield and its quality. This paper is also indicating challenges in integrated weed management practices with raising a question why a majority of farmers around the world are unable to apply integrated weed management (IWM) practices.

Key words: Weed control, Yield losses. Crops, Higher yield, Views

INTRODUCTION

The agricultural interest of world is to obtain maximum crop yield and fulfill the food, feed and fiber requirements in competition of fast increasing population. This interest of the glob is damaged by the weeds. Weeds directly reduce the crop yield and deteriorate its quality. Ofor *et al.*[1] reported that weeds as pests, highly reduce the production of the crops. They extract nutrients, water and moisture available in soil and also compete for light and air and negatively affect the crop. They limit the crop yield by limiting plant-food resources from which plant receives the energy for their growth and development Shad.[2]. Critical crop growth periods are very much important in all crops at which weed competition for nutrient and water resources plays significant effect on yield. It varies with crop to crop. It is shown between 30-60 days in wheat crop after sowing, Ahmad and Sheikh [3]. Delay emergences of weeds in crop have negative impact on yield. Kells. [4]. Weed heavily losses the crop productivity. In rice crop about 60-70% yield reduces due to infestation of weeds and it is a higher yield loss than any other pest. Azmi. [5] and sugarcane crop is damaged up to 20 to 25% by the contaminant of weeds. Khan *et al*. [6]. In share of it, Baloch *et al.*[7] reported that low yield losses in sugarcane are caused by high weed infestation. Among oil seed crops yield losses due to weeds are 27 to 77% in soybean crop, Gogoi *et al*. [8]. Kachroo *et al*. [9] investigated that loss of crop yield can be higher up to 84% due to weed attack level. Moreover During weed crop competition the production cost of per hectare increases as compared to weed free crop. In black seed weeds can reduce the yield up to 60 to 85%, Ahmad and Ghafoor. [10]. Weed infestation is not minimum in wheat crop as well, in wheat crop, weeds contributes 25 -30% yield reduction, Nayyar *et al*. [11]. This is due to weeds which create stressful periods by obtaining the major share from nutrients, water, moisture, sunlight and space, Anderson [12]. In horticultural crops weeds are also serious problem which attack the major objective of horticulture that is quality of produce. Lower quality and limited yield of horticultural crops is mostly resulted from climatic factors such as humidity, sunlight intensity, rainfall and drought but among biotic factors weed infestation is included as a major factor, Iremiren.[13]. When weeds could not be controlled during crop growth period, they minimize the yield, Kavalinuskaite and Bobinas, [14] and in this way they provide maximum losses, Anwar *et al.*[15] but weeds are difficult to control because they multiply very fast and a single plant contains thousands of seeds. Anderson,[12] reported that some weeds produce lots of seeds i.e. Redroot Pigweed (*Amaranthus retroflexus*) produces 117,000 seeds/plant, Common Purslane (*Portulaca oleracea*) produces 52,000 seeds/plant, Shepherd's Purse (*Capsella bursa-pastoris*) produces 38,000 seeds/plant, Common Lambsquarters (*Chenopodium album*) produces 28,000 seed/plant and Yellow Foxtail (*Setaria glauca*) produces 12,000 seeds/plant. Annually weed losses maximum crop yield in various main crops that contribute food scarcity in the world. Farmers use many methods to control the weeds. Generally farmers control the weeds through well land preparation, Khan and Saghir, [16]. Therefore this research review work shows white paper against weeds and provides possible remedies for obtaining higher crop yield.

WEED CONTROL PRACTICES

Weed control practices are mean to use weedicides, hoeing, tillage operations, hand pulling, mulching, intercropping, cultivation of weed competitive varieties, use of pure seed, seed rate, use of fertilizers, mixed cropping, crop rotation, sowing time and sowing methods.

Use of weedicides: Generally chemicals such as weedicides are extensively used in crop production system throughout the world. Weedicides (Weed killing chemicals) are used in all crops. It is known as effective and rapid control of weeds than any other method. Weedicides are available in pre and post

emergence formulas for suppression of weeds before they give losses to crop. In crop production, perennial weeds are very difficult to control such as *phragmites karka, Cynodon dactylon, Demostachya bipinnata, Phragmites commnis* and *Cyperus rotandus* etc. They are mostly controlled through the use of systemic herbicides including glyphosate and dalapon etc. while atrazine, diuron, paraquat, simazine and some growth regulators are also used to control annual broad leaved weeds, Okezie, [17]. Among them, 2, 4-D is best resultant at post-emergence application against broad leaved weeds. Moreover herbicide damages the weeds with most efficiency and does not give any high level negative effect on soil and environment, Katung and Ngu, [18]. It is an economic method which requires less labor, Gogoi *et al.*[19] easy and effective against many weed species, Chandra *et al.*[20].

Hoeing: Hoeing with hand is a historical weed control method in agriculture before activation of technology and it has been continually used in crop production for maximum crop yield. This practice is effective for all crops. Some time when crops as well as weeds become mature in a standing crop due to less attention of farmers then they cannot be controlled completely through the use of chemicals and famous weedicide products provides failure results. At that time hoeing plays important role for weed control and effectively controls the weeds. Hoeing is a most suitable method of weed control and it is recommended for soybean in getting maximum yield, Rakesh and Shirvastava[21]; Galal[22]. Funding it, hoeing with hand increases the yield and appropriately eradicates the weeds, Ahmed *et al.*[23].

Tillage operations: Tillage means to till, pulverize, manipulate and explore the soil. Deep tillage operations is useful to control the weeds because they destroy weeds from their living roots so, weeds do not germinate again, while sprayer weedicides destroy the weeds from leaves and stem (All above the ground parts of plants) which results in re-germination of weeds in crop land. However, these are effective for short term and tillage practices are effective for long term suppression of weeds. Deep ploughing significantly increases crop yield by reducing weed infestation in context with surface tillage or minimum tillage which does not reduce weeds meaningfully in any crop, Mishra *et al*. [24].

Hand pulling: The practice of hand pulling of weeds is considered as a good weed practice but it is usually time consuming and less effective when crop is widely infested by weeds. This method is useful on regular basis, very few hard working farmers do this activity and save the crop from weed infestation. Organic farming recommends this method where chemicals are not used for controlling the weeds. Hand weeding is a traditional and slower method of weed control which consumes much time and labor, Khan and Saghir [16], small number of farmers use this practice to control the weeds because it is a difficult field operation, Byerlee *et al.* [25].

Mulching, Cultivation of weed competitive varieties and Sowing Time: Mulching, growing weed competent varieties and sowing time are important in controlling the weeds. These practices are key aspects of agriculture and widely recognized in crop production for weed management activities, Hutchinson and Eberlein [26].Mulching reduces the weed infestation, it is famous, easy and less cost full. Small land farmers use mulching in an easy and good way, not only for weed control but also for conserving moisture content of the soil, supply of essential nutrients, enhancing soil fertility, improves soil texture and structure and for obtaining good quality produce of crop and maximum yield, Owombo *et al.*[27]. Weed competent varieties are almost rapid in growth and development from genetic material because they are genetically improved and timely sowing provides healthy and vigor plants which are able to compete with weed plants for nutrient and water and other resources. Sowing of crop at proper time is also an important thing, this provides best quality produce and an increase in yield, Chauhan [28] and late cultivation of crop negatively results on crop growth and yield. It minimizes the yield by the causes

of weed competition with crop, Caton *et al.*[29]. Delay sowing adversely affects on growth and yield components of crop So, optimum time of sowing is necessary for better crop yield, Mishri and Kailash, [30]. Rice sown in first week of June gives good performance against weed as compare to rice sown in first week of July. It is proved that early sowing highly reduces the weed dispersions, Mubeen *et al.*[31].

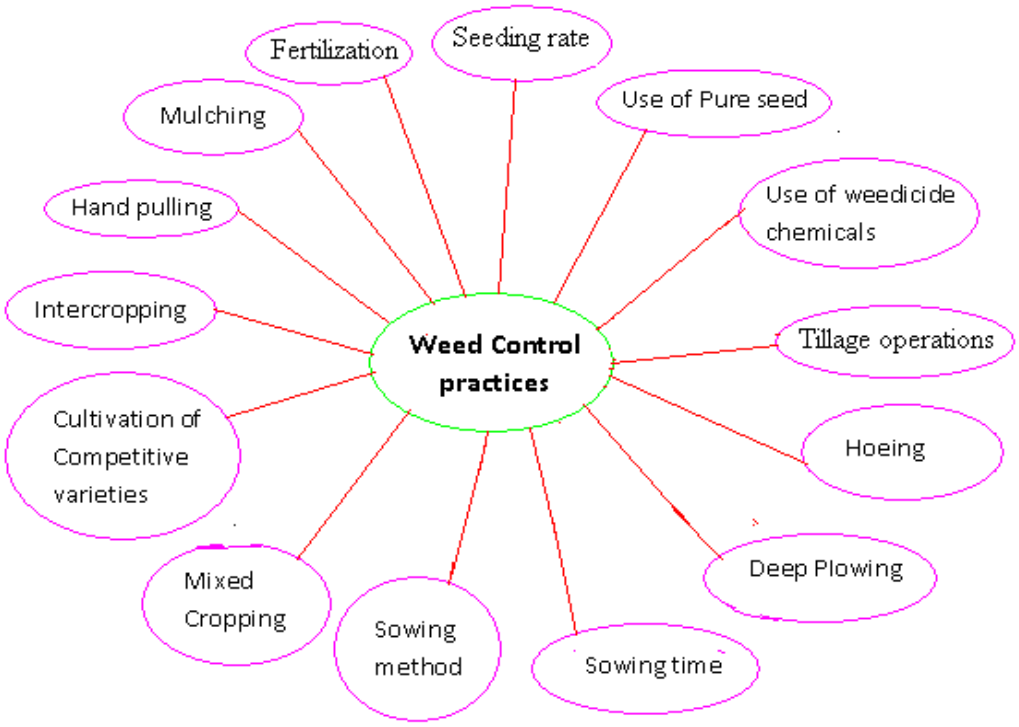


Figure1: Different weed control practices for crop protection

Use of pure seed: For better weed control the basic thing is the use of pure seed in any crop. Impure seeds contain weed seeds which result in weed germination, growth and development together with crop throughout its growth period. Pure seed provides early germination and rapid response to available nutrients and water in soil than impure seeds that establish the crop after weed germination and limits the resources for crop to germinate. Moreover if crop land is already free from weeds then there is no chance for weed infestation in use of pure seed while impure seeds can cause weed infestation. Pure seeds definitely provides maximum crop yield. For that, certified seed should be used that insures the purity, Owombo *et al.* [27].

Crop rotation: Crop rotation is found suitable for weed control and maximize crop yield. Weed germination and growth disturbs through change of crop in each season at same crop land such as wheat crop rotation with mustard crop is most helpful to reduce weed infestation. Plant population of mustard is higher that suppresses the weeds at minimal level. Same as cotton can be best rotated with millet and other crops. Crop rotation has become good practice when suitable crops are cultivated in its circle. Gheorghe and Stelian [32] reported that rotation of three to four years in wheat crop is effective for weed control and is found as good protection measure from Fusarium species of weeds which are most dangerous and significantly reduce yield.

Sowing methods: Many researchers around the world determined that sowing methods are important for reduction of weed magnitude, like rice crop usually sown by transplantation but due to difficulty now days world's farmers are using direct seeding rice (DSR) method, Farooq *et al.* [33]. Direct seeding method increases weed infestation due to unavailability of flood water in early stage of crop. Heavy flooding in rice suppresses the weeds and reduces weed crop competition, Singh *et al.* [34]. Direct seeding of rice is easy, cheap and less time consuming over the transplantation but risk of weed infestation is higher in this method. So, world's farmers have to take attention in choosing best sowing method of rice crop to avoid weed infestation.

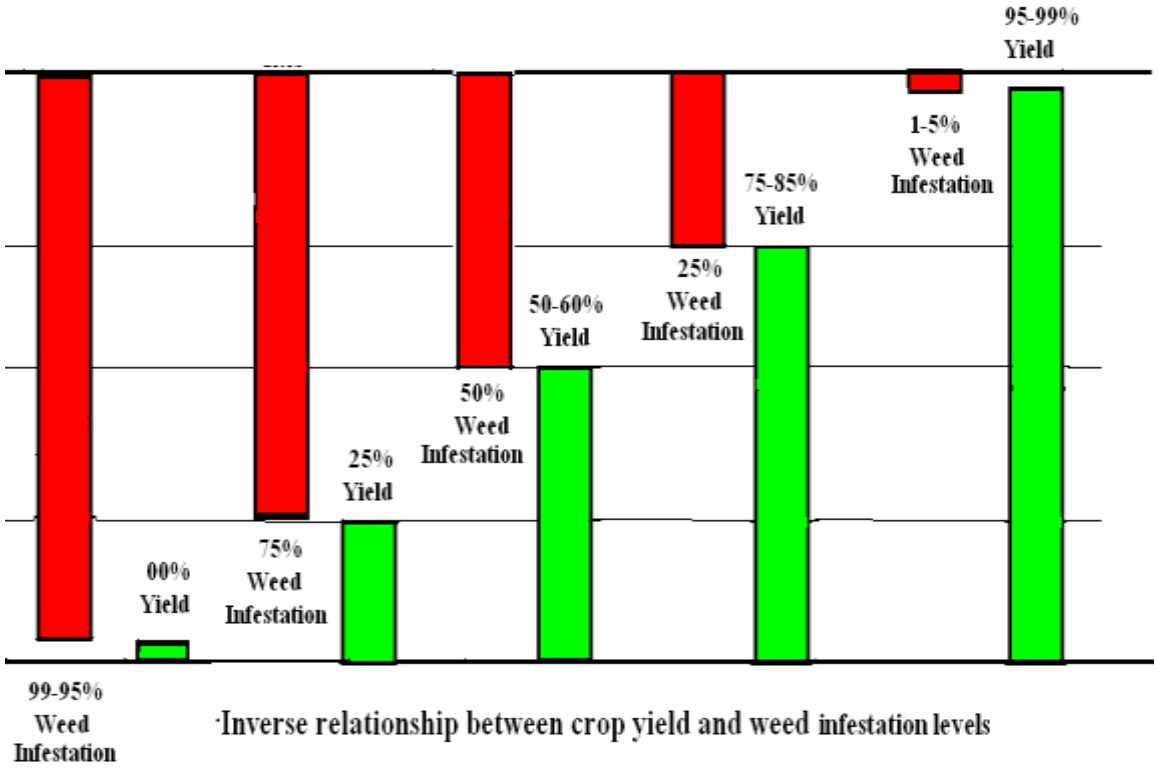


Figure 2: Effect of increasing and decreasing infestation rate of weeds on crop yield

Seed rate: Seeding rate has become crucial in crop production. It provides maximum plant population. Maximum number of plants effects on weeds in several ways, among them the main key aspect is space. No free space will be available for the growth and development of weed plants when maximum numbers of crop plants are growing simultaneously. If weed plants grew they will be thinner in stem and weak in overall growth and yield constituents. They cannot adversely effect on crop. In wheat and mustard crop the high seeding rate is very much important against weeds. Increase of seed rate varies with crop to crop and weed attack threat; it can be up to 20 to 90% extra seed with recommended seed rate.

Fertilization: Some weed plants respond too much to fertilizers than crop plants. Thus they grow vigorously and damage the crop. Application of fertilizer should be at judicious time. Application of fertilizers in highly infested field will cause many problems. It will increase weed plant population and its vegetative growth that ultimately affect the crop. High dose of fertilizer should be applied early when

most seasonal weeds have not started germination yet and lower dose should be applied with monitoring weed attack. Fertilization in rows of crops with major elements has significant function as compare to application of fertilizer in broadcast method because maximum nutrient (fertilizer) directly reach the crop root zone, while broadcast fertilizers can wrongly be dispersed and can become available to the weed plants.

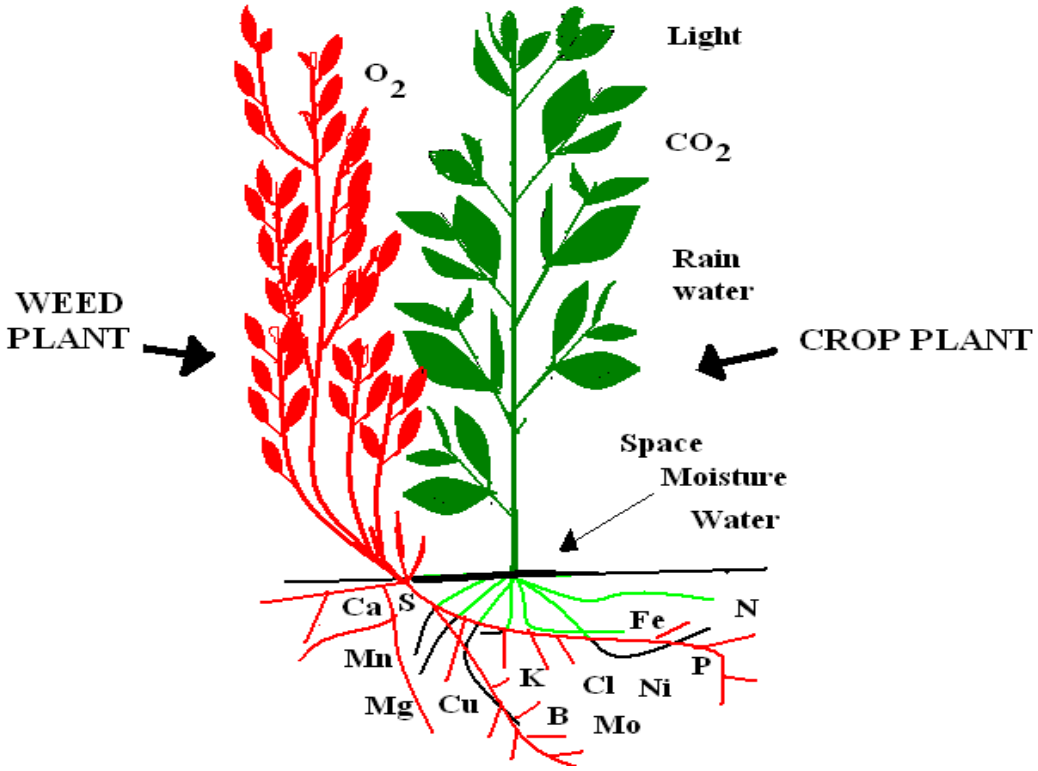


Figure 3: Weed plant giving tough time to the main crop plant for growth in different ways for different resources

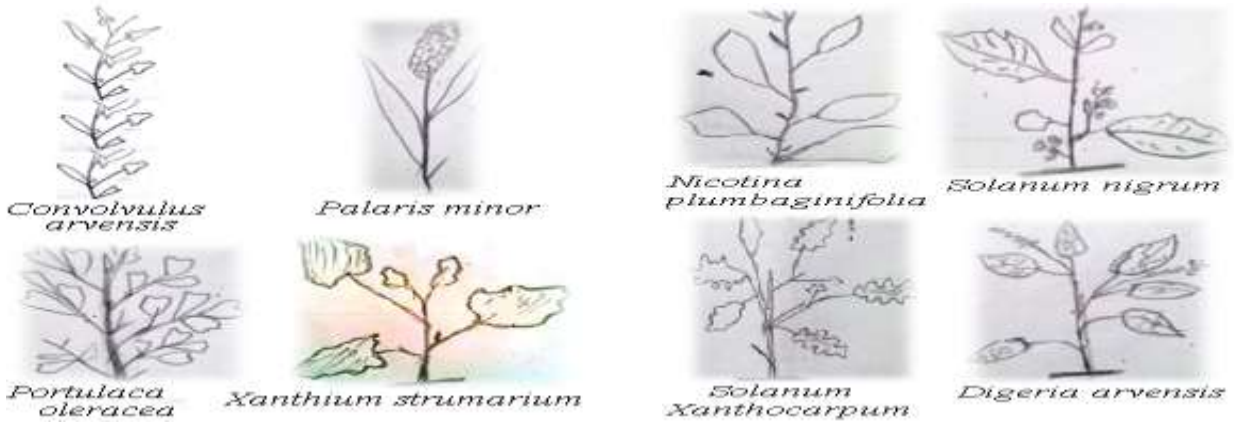
Mixed Cropping: Mixed cropping means growing more than one crop at same field and time simultaneously. One crop should be weed competitor that reduces the weed growth and development. Such as Mustard crop is taller in height, rapid in growth and development can be best mixed with seasonal vegetable crops. From the roots point of view this crop gives tough time to weeds for nutrients and water extraction and in open sky, it shades the weeds thus limits the light availability which is most necessary for photosynthesis process of weeds. Weeds then grow weaker with thinner stem and yellowish leaves. They show symptoms of light deficiency. Wheat crop can be mixed with more than 10 crops in which mustard, gram and linseed are important and commonly cultivated with wheat for minimization of weed infestation and for getting maximum profit. Minimum seed rate of minor crops should be mixed with major crop is recommended, in areas where weed infestation is greater.

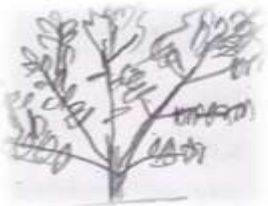
Intercropping: Intercropping system means growing of two or more crops in different rows of same land. Generally high weed infestation can be found near the inner sides of bunds of cropped field. Cultivation of weed challenging crops from 2 to 4 feet of inside area of bunds assists to control the weeds

and protect the main crop. Weeds on bunds cannot be spread in whole field because minor crops restrict them and will play a role as a shield.

Integrated weed management (IWM): The concept of integrated weed management is that "a combined action against weeds which involves all available resources to control the weed population and obtain maximum crop yield." IWM is useful but it is a difficult practice. Thus its adaptation is a challenge among third world countries. Farmers of poor countries cannot use it as a best tool against weeds due to lack of resources and economic problems such as rotation of crop is not possible due to profitability, high seeding rate increases cost ha^{-1}, mulching is not suitable for large scale farming, changing sowing time of crops is difficult due to climatic conditions, sowing method increases the cost for cultivation of crops and deep plowing for good seedbed also raises cultivation costs. In Pakistan weedicides are only used as a major source of weed control in any crop and it is noted that Pakistani farmers choose low price weedicides than the products of famous companies which are high in price. For weed control various scientists has recommended integrated weed management (IWM). Swanton and Weise[35] reported that Integrated weed management (IWM) comprises on mechanical, biological and cultural practices. It gives information about sustainable weed control techniques through the less cost, Rao and Nagamani, [36]. Combined action of weed control practices is a complete code for controlling weeds that concludes significant results, while any other weed control practice is ineffective alone if used to control the weeds, Knezevic *et al.* [37]. Mutual use of different weed control methods reduces weed infestation and it restricts the dispersal of weeds at minimum level which cannot give adverse effects, Blackshaw *et al.*[38]. Integration of cultural, mechanical, chemical and physical weed control practices can be best and combination of hand weeding with weedicides such as 2, 4-D proved extra ordinary results, Naklang, [39]. Leghari *et al.* [40] observed that calcium carbonate plus stored farm yard manure (FYM) not only supply nutrients but it also kills the weeds and restrict them from re-germination. These research works favors integrated weed management (IWM) as it definitely is a set of planned actions against weeds which can be further improved by adaptation of free of cost techniques raised from latest research and a strategy should be modernized with ''Integrated Weed Management by Self Supporting Techniques'' (IWMSST) in which farmer's friendly weed control methods should be added which are favorable in all suitations and aspects.

DRAWING IMAGES OF SOME MOST COMMON WEEDS IN MAIN CROPS OF SINDH, PAKISTAN



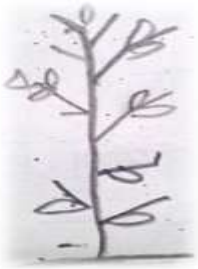

Cressa cretica


Cyperus Iria


Chenopodium album

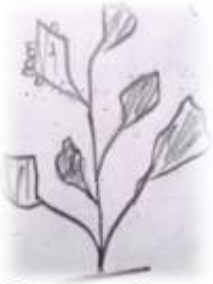

Plygonum plebejum

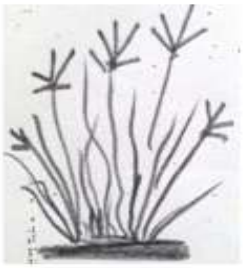

Cyperus rotundus


Alhaji camelorum


Angallis arvensis


Argemone mexicana


Chenopodium murale


Cynodon dactylon


Fumaria indica

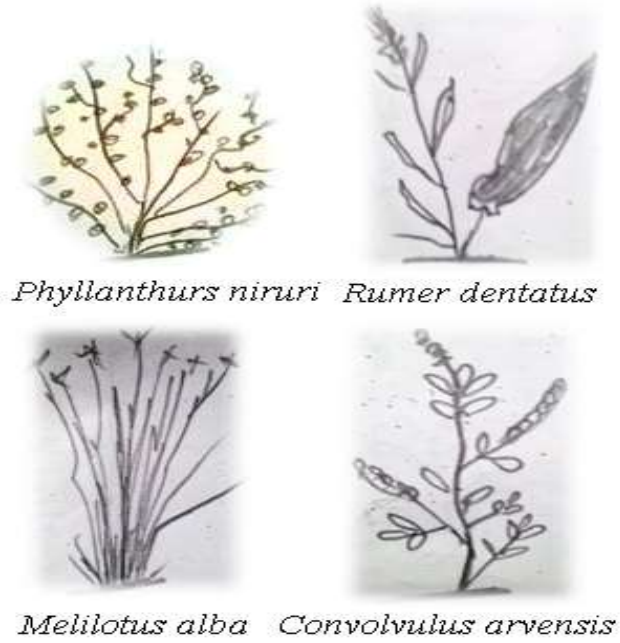

Sonchus asper


Avena fatua


Heliotropium indicum


Echinochloa colonum


Triblus terrestris



CONCLUSION

This study suggests that weed control at proper time and selection of proper method is crucial for all agricultural crops. Higher yield can be achieved through better crop care and by effectively suppressing the weeds. Weeds cause maximum losses in agricultural crop productivity that can be included as a huge factor which limits the yield. Weeds lead to various crop stresses, among them nutrient stress and water stress are unavoidable. This Paper is also indicating on effective weed control methods for different crops and brightening the knowledge of farmers that how much and how weed losses the crop yield and how to control them.

REFERENCES

1. M. Ofor, O. Ibeawuchi, I.I, A. M. Oparaeke.*Nature and science*. 2009,**7**:45-51.
2. R.A. Shad. *Progressive Farming.* 1987, **7**: 10-16.
3. R. Ahmad, A.S. Sheikh. *Pakistan Journal of Water Resources*. 2003, **7**: 73-74.
4. J.J. Kells, Proc. *Illinois Crop ProtectionConference.* 1999, 63-64.
5. M. Azmi. *Journal of Trop. Agric. Food Science*. 2002, **30**:151-161.
6. B. Khan, M. Jama, H. Azim.*Pakistan Journal of weed Sci. Res.* 2004, **10**: 47-50.
7. S. Baloch, M. I, H. Shah, I. Hussain, K. Abdullah.*Pakistan Sugar Journal.* 2002, **17**: 13-14.
8. A.K. Gogoi, H. Kalita, A.K. Pathak. *Indian Journal of Agronomy*. 1991, **36:**453-454 (1991).
9. D. Kachroo, A.K. Dixit, A.S. Bali. *J. Res. SKUAST –Jammu.* 2003, **2:1**-12 (2003).

10. Z. Ahmad, A. Ghafoor. *Project on introduction of medicinal herbs and species as crop. 2004*. 1-25.
11. M. Nayyar, M. M. Shafi, M.L. Shah, T. Mahmood. *Weed Management forSustainable Agriculture. Proc. 4th All Pakistan Weed Science Conference*. 1992, 147-53.
12. W.P, Anderson, *Weed Science,'' Principles. 2nd Ed. St. Paul, MN: West Publishing Company.*1983.
13. G.O. Iremiren. *Expl. Agric.*1988, **24**:12-20.
14. D. Kavalinuskaite, C. Bobinas.*Agronomic Res*. 2006,**4**: 217-220.
15. S.Anwar, W.A. Shah, J. Bakht, U. Jabeen. *J. of Agronomy*. 2004,**3**: 59-67.
16. M.A.Khan, R.A. Saghir. *Pakistan J. Agric. Res*.1987,**8**: 278–80.
17. A. Okezie, *Abstract of III International Weed Science Congress USA*. 2000, 124-128.
18. P.D. Katung, N.E. Ngu. *Walp. Samaru Journal of Agricultural Research*. 2003, **19**: 37-46.
19. S. Gogoi, P.H. Gogoi, A, Mazunder, T.P Saikua.*Ann. Agrc. Res*. 1997,**18**: 432-436.
20. S.Chandra, A. N. Tiwari, R. Singh. *Indian Agri. Sci. Dig*. 1998,**18**:71-72.
21. K.S. Rakesh, U.K. Shirvastava. *Indian J. Agron*. 2002,**47**:269-272.
22. A.H.Galal. *Assiut J. Agric. Sci*. 2003, **34**:15-32.
23. S.A.Ahmed, S.A. Saad El-Din, I.M. El- Metwally. *Annals Agric. Sci. Moshtohor*. 2001,**39**:805-823.
24. J.S. Mishra, V.P Singh, N.T Yaduraju. *Indian J. Agronomy*.2005, **50**: 106-109.
25. D. Byerlee, P.R. Hobbs, B.R. Khan, A. Majid, R. Akhtar, N.I. Hashmi.Increasing wheat productivity in the context of Pakistan'sirrigated cropping systems, *A view from farmers fields PARC/CIMMYT*. 1986, 86-96.
26. P.J.S. Hutchinson, C.V. Weed management. *J. C. Stark and S. L. Love, Eds, In: Potato Production Systems. Moscow, ID: University of Idaho Agricultural Communications*. 2003, 241-283.
27. P.T.Owombo, O.Z. Aregbesola, K.A. Adeloye.*J. Agri and Sustain*. 2014, **6**:179-199.
28. B.S. Chauhan, *J.Weed Techno*. 2012,**26**:1-13.
29. B.P. Caton, T.C Foin, J.E. Hill. *Field crops Res*. 1999,**63**: 47-6.
30. L.S. Mishri, P.B Kailash. *Nepal agric. ResJ*. 2005, 6:35.
31. K.Mubeen, M.A. Nadeem, A. Tanveer, A.J. Jhala. *J. Ani & Plant Scie*. 2014, **24**:534-542.
32. P. Gheorghe, I. Stelian, *Research Institute for Cereals and Industrial Crops, 8264 Fundulea, Cãlãraºi, Romania*. 1998, 83-91.
33. M.K.Farooq, H.M. Siddique, H. Rehman, T. Aziz, D.J. Lee, A. Wahid. *Soil Till. Res*. 2011,**111**:87-98.
34. S. Singh, J.K. Ladha, R.K. Gupta, L. Bhushan, A.N. Rao, B. Sivaprasad, P.P. Singh. *J. Crop Prot*.2007, **26**:518-524.
35. C.J. Swanton, S.F. Weise. *J. Weed Technology*. 1991, **5**: 657-63.
36. A.N. Rao,N. Nagamani. *Indian J. Weed Sci*. 2010, **42**: 123-135.

37. S.Z.Knezevic, A. Datta, C. Bruening,G. Gogos., G. Propane-Fueled Flame Weeding in Corn, Soybean and Sunflower. University of Nebraska, Lincoln Extension Service 2012; Accessedfrom (http://www.agpropane.com/uploadedFiles/Agriculture/Program_Safety_On_The_Farm/Flame%20Weeding%20Training%20Manual_08-27-12_final%20(2).pdf on May 24, 2014.
38. R.E. Blackshaw, H.J. Beckie, L.J. Molnar, T. Entz, J.R. Moyer. *J.Weed Sci*. 2005, **53**:528-535.
39. K.Naklang, Direct seeding for rainfed lowland rice in Thailand, In: Breeding Strategies for Rainfed Lowland Rice in Drought-prone Environments: Proceedings of an International Workshop, Ubon Ratchathani, Thailand, November 5-8, 1996.
40. S.J. Leghari, U. Ali, G.M. Leghari, M. Buriro. *J. of Plant Stress Physio*. 2015, **1**: 23-25.

Corresponding author: Shah Jahan Leghari;

Department of agronomy, Sindh Agriculture University Tandojam,

District Hyderabad, Sindh, Pakistan