Indian Journal of Weed Science **53**(1): 73–77, 2021

Print ISSN 0253-8040 Online ISSN 0974-8164

Farmers' knowledge level and constraints faced in the adoption of weed management technologies

Yogita Gharde* and P.K. Singh

ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India

**Email: yogita_iasri@rediffmail.com*

Article information

DOI: 10.5958/0974-8164.2021.00010.1

Type of article: Research article

Received : 21 December 2020
Revised : 8 February 2021
Accepted : 11 February 2021

Key words
Adoption

Chemical weed control

Factor analysis

Herbicide

Weed management

ABSTRACT

One common problem for the organizations and individuals involved in the transfer of the agricultural technologies is how to accelerate the adoption rate of technologies; which is mainly influenced by many factors such as simplicity of the technology, relative advantages, etc. Further, after the adoption of technology, the question arises that for how many years the farmers practiced the technology. In the present work, knowledge and awareness level of farmers on weed management technologies and constraints faced in the adoption of these technologies were studied. Primary data were collected from the farmers of different parts of India selected by random sampling using detailed pre-tested interview schedule and comprising a total of 412 farmers in the sample. Awareness level of farmers on weed management including chemical method were checked using statistical methods such as descriptive statistics. Parameters explaining the awareness level of the farmers on weed management, in general and chemical weed management, in particular, were subjected to factor analysis. Varimax rotation technique was used as solution pertaining to different factors. Two factors were selected for further interpretation which explained 72.6 and 84.3% variability in the level of awareness among farmers on weed management and chemical method of weed control, respectively. Study showed that the risk associated with the use of herbicides was the major constraint for non-adoption of this technology. Further, other major constraints were lack of technical knowledge about herbicides; lack of awareness about improved weed management technologies and lack of knowledge about the precautions during spray of herbicides.

INTRODUCTION

Problem of weeds has now become a constant issue in agricultural production owing to its dynamic and resilient nature. Weeds compete for light, water, and nutrients with crop plants which results in substantial crop yield losses (Swanton *et al.* 2015, Ramesh *et al.* 2017). In a recent study, total economic loss of about USD 11 billion was estimated due to weeds in 10 major field crops in India (Gharde *et al.* 2018). Therefore, minimizing the yield loss due to weeds in short-term and reducing the weed seeds in soil seed bank are the two simultaneous objectives of weed management (Chauhan *et al.* 2017). Owing to economical in nature, some researchers have recommended the use of herbicides as compared to mechanical method of weed control (Gianessi 2013, Muoni *et al.* 2013). Therefore, herbicides may be considered as efficient tool in controlling weeds, and thus, their appropriate use can lessen the yield losses caused by weeds up to 13% (Oerke and Steiner 1996). However, over dependence on chemicals in many established regions has increased the levels of resistance in some weed species (Culpepper *et al.* 2004; Hall *et al.* 2014), making the use of herbicides more doubtful and less sustainable in the future as far as environment is concerned. Some researchers have shown that other methods such as use of cover crops, and retaining their residues in cropping systems, are very efficient in controlling weeds. However, this may because of other issues such as shift in weed flora, and the value for weed control is dependent on the performance of each specific cover crop (Mhlanga 2015). Research has also highlighted some of the other challenges encountered with the use of cover crops, such as the preferences of the farmer and the availability of seed. In view of the problems associated with different methods, it is obviously expected that Integrated Weed Management (IWM) would stay as the most acceptable and prominent method in near future also.

However, with many prominent technologies for weed management in hand, one common problem for the institutions and individuals involved in the transfer of the agricultural technologies is how to speed up the rate of adoption of technologies among farmers influenced by many factors such as simplicity of the technology, relative advantages, etc. (Rogers 1983). Recently, adoption and impact of weed management technologies in rice and wheat in India was studied (Singh and Gharde 2020). Many researchers have proved that the awareness level of the farmer has significant role on adoption of IWM. Further, knowledge level improves with education, farming experience, training, accessibility to farm machineries, extension contacts and innovativeness (Rajashekhar *et al.* 2017, Singh *et al.* 2018). Keeping these points in view, we studied the awareness level of farmers on weed management in general and chemical weed control technologies in particular along with constraints faced by the farmers in the adoption of these technologies.

MATERIALS AND METHODS

To understand the awareness level of weed management technologies among farmers of India, present study was conducted during 2014-17 at ICAR-Directorate of Weed Research, Jabalpur. Primary data were collected by centers of All India Coordinated Research Project on Weed Management from the farmers of different parts of India selected through random sampling using detailed pre-tested interview schedule and thus comprising a total of 412 farmers (respondents) in the sample. Questions were mostly descriptive and in the form of 4 point Likert scales ranging from 0 (disagree) to 3 (highly agree). Awareness levels of farmers on weed management were checked using statistical methods such as descriptive statistics and factor analysis. Parameters explaining the awareness level of the farmers on weed management and chemical weed management were subjected to factor analysis. This method was applied to decide the most important factors related to the awareness level of famers. Data suitability for factor analysis was checked using Kaiser's Measure of Sampling Adequacy (MSA). The latent root criterion and proportion explained by the factors were used to decide the number of factors to be included in further interpretation of the results. Varimax rotation technique was used as solution pertaining to different factors.

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers

The data showed that 46% of the respondents were educated upto secondary level, however, some of them (17.7%) were also under-graduate. More than 95% of the farmers had agriculture as the main occupation and major source of income. Among all respondents, almost half (48.7%) of the farmers have 15-30 years of experience in farming. Data also showed that average annual income of the respondents was Rs. 263466/- which is expected to be from their primary occupation i.e. farming. However, more than half of the respondents (55%) have income less than Rs. 2,00,025/-. It was observed that average land holding of the farmers was 2.8 hectare whereas, 37% respondents owned land less than 1 hectare.

Awareness level of the farmers on weed management

Farmers were interacted to give the information on their awareness level on different weed management options and were asked to score their answers in the form of 4 point Likert scale ranging from 0 (disagree) to 3 (highly agree). Data was analyzed using factor analysis to find the important factors which are prominent in explaining the awareness level of farmers on different weed management options. Descriptive statistics and results of factor analysis are presented in **Table 1**. It can be seen from mean values of **Table 1** that the maximum number of farmers strongly felt that weeds are major obstacles in crop production and still majority of the farmers use hand weeding as most

Table 1. Mean, standard deviation and factor analysis component of awareness on weed management technologies

Reaction	Mean	Std. Dev.	Varimax rotated component	
			Factor 1	Factor 2
Weeds are one of the major obstacles in crop production	2.54	0.645	-0.098	0.393
In traditional farming system, weed management was not given due importance	1.33	0.986	0.154	0.463
Use of hand weeding as weed control methods	2.11	0.804	0.052	0.099
Hand weeding is used currently by farmer	1.48	1.01	-0.092	-0.219
Improved Weed Management technologies give better weed control and yield than traditional method	2.04	0.814	-.0177	0.448
Received information on suitable herbicide and their required doses	1.96	0.685	0.848	-.0176
Received information on suitable time and method of application of recommended herbicide	2.06	0.844	0.833	0.112
Use of demonstrated Improved Weed Management technologies by farmer	1.59	1.03	0.052	0.702
Awareness on preventive methods of weed management	1.68	0.709	-0.127	0.042

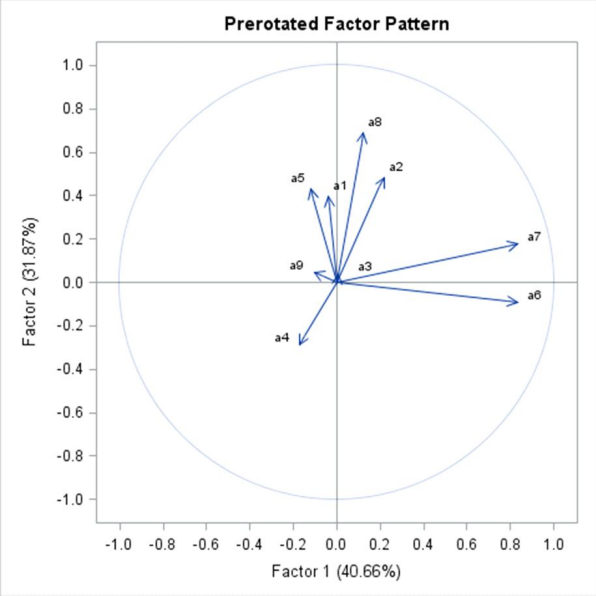


Figure 1. Pre-rotated factor pattern using varimax method in factor analysis for studying awareness level on weed management technologies

preferred weed control method. In factor analysis, Kaiser's MSA was observed as 0.56 which ensures the suitability of data for factor analysis. Factors were selected based on eigenvalues and proportion to be explained by the factors. In this case, two factors were selected which explained 72.6% variability altogether. Factor 1 explained about 40.7% of variability and had loadings from information on suitable herbicides and their doses and suitable time and method of application of herbicides. Whereas, factor 2 accounted for 31.9% of variance and had heavy loadings from use of demonstrated Improved Weed Management technologies by farmers; in traditional farming system, weed management was not given due importance; Improved Weed Management technologies give better weed control and yield than traditional method. **Figure 1** showed the pre-rotated factor pattern using varimax method for studying awareness level of farmers on weed management technologies.

Awareness level of the farmers on chemical method of weed control

Farmers were asked to give the answer of questions pertaining to awareness level of farmers on chemical weed control in two point scale 1 (agree) and 0 (disagree). Descriptive statistics and results of factor analysis performed on factors describing awareness level of the farmers on chemical weed control are presented in **Table 2**. Mean values presented in the **Table 2** showed that most of the farmers felt that herbicide application is better and easy; they avoid herbicide spray during high speed wind and cloudy weather; they know appropriate time of application of post-emergence herbicide. Further, factor analysis of the data with 11 parameters resulted the Kaiser's MSA value as 0.68, ensuring the suitability of the data for factor analysis. Two factors were chosen which accounted for about 84.3% of total variance. Factor 1 explained about 63.4% of variability and had loadings from appropriate time of application of post-emergence herbicide; pre-emergence herbicide; presence of sufficient moisture in soil during application of herbicides. Thus, factor 1 more focused on technical knowledge on use and application of herbicides. Further, factor 2 explained about 20.9% of variability and had more loadings from knowledge on spurious/ adulterated chemical and their availability in local market; precautionary measure used during spraying such as mask/cloth/gloves; use of specific nozzle like flat fan for spraying herbicides. **Figure 2** presents the information on pre-rotated factor pattern obtained using varimax method in factor analysis conducted to explain the awareness level of farmers on chemical weed control.

Table 2. Mean, standard deviation and factor analysis performed on factors describing awareness on chemical method of weed control

Opinion	Mean	Std. Dev.	Varimax rotated component	
			Factor 1	Factor 2
Herbicide application is better and easy	0.955	0.207	0.300	-0.012
Mechanical weeding/hand weeding is better than herbicides	0.810	0.393	0.115	-0.068
Knowledge about appropriate time of application of pre-emergence herbicide	0.873	0.390	0.743	0.113
Knowledge about appropriate time of application of post-emergence herbicide	0.875	0.331	0.809	-0.092
Necessity of sufficient moisture in soil during application of herbicides	0.822	0.383	0.688	0.034
Avoid herbicide spray during high speed wind and cloudy weather	0.914	0.281	0.393	-0.130
Use of precautionary measure during spraying (mask/cloth/gloves)	0.525	0.500	0.116	0.447
Idea about spurious /adulterated chemical and their availability in local market	0.543	0.499	-0.160	0.550
Use of specific nozzle like flat fan for spraying herbicides	0.724	0.448	0.315	0.334
Herbicide container is destroyed after use	0.599	0.491	0.433	0.058
Herbicide is sprayed with other pesticides (by mixing)	0.810	0.393	-0.001	0.151

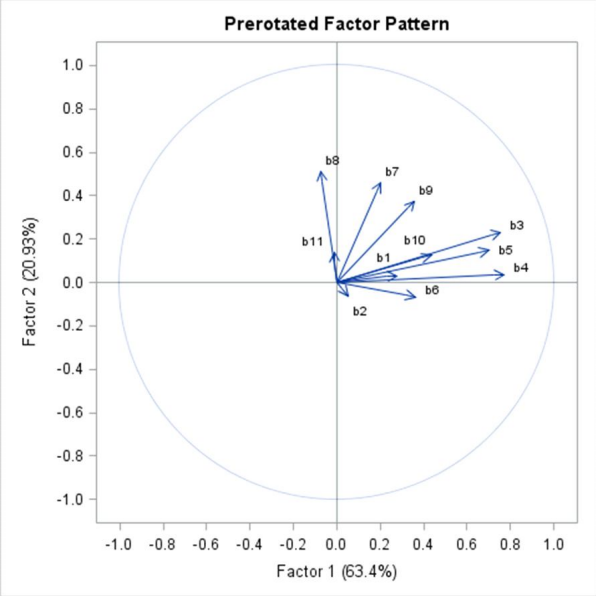
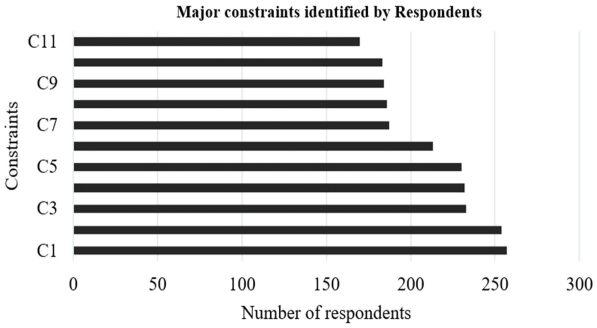


Figure 2. Pre-rotated factor pattern using varimax method in factor analysis component of awareness level of farmers on chemical weed control

Identification and prioritization of constraints faced by farmers in adoption of chemical method of weed control

While the rate of adoption of herbicides in different crops is encouraging, its adoption as profitable method of weed control (in terms of yield increase and cost saving) faces many constraints. Some of the main constraints identified by the farmers in the present study areas are summarized in **Figure 3**. Results showed that risk associated with the use of herbicide was the major constraint for non-adoption of these technologies. Further, other main constraints were lack of technical knowledge about herbicides; lack of awareness about Improved Weed Management technologies; lack of knowledge about the precautions during spray. (Debrah 1994) reported that technical complexity and a non-availability of adequate information may restrict the adoption of weed management technologies for *Striga* in the West African semi-arid tropics. In the present study, there were 170 farmers who endure less risk bearing capacity about new technology. Further, economic concerns also play a major role in farmer decisions related to weed management. They generally adopt the practices that are economically more beneficial in the short term (Liebman *et al.* 2016). For implementing weed management practices in order to adopt them, special attention to their perceptions, goals, and decision-making processes are necessary. Further, educating the extension officers may be one of the best way of delivering scientific information to the farmers and thus to increase the adoption rate of weed management technologies (Liebman *et al.* 2016). Udensi *et al.* (2012) also reported the constraints like technical know-how or application problems (16.5%) and high cost of chemical (14.9%) among main constraints in their study. High cost of herbicides was also found as one of the constraints in our study. (Adesina and Forson 1995) reported that the adoption of any technologies by the farmers reflects decision-making based upon their observation on the appropriateness of the characteristics of the disseminated technologies. Therefore, adoption can be expected to be dependent on the cost of a technology and on whether farmers possess the required resources.

The study indicated that 46% of the farmers were educated upto secondary level with high literacy rate among farmers. It is expected that educated farmers who have exposure to new technologies and innovations, are more interested to new ideas and are ready to adopt (Udensi *et al.* 2012). The findings from study established that most of the farmers possess more knowledge about chemical method of weed control. However, information on suitable herbicides and their doses; suitable time and method of application of herbicide; use of demonstrated Improved Weed Management technologies; Improved Weed Management technologies give better weed control and yield than traditional method.; in traditional farming system, weed management was not given due importance are main factors to explain



C1: If anything happens wrong due to use of herbicide, there is no recovery mechanism; C2: Lack of technical knowledge about mixture of two herbicides for effective broad-spectrum weed control and time / labour saving; C3: Lack of awareness about IWM technologies; C4: Lack of knowledge about the precautions during spray; C5: Lack of proper technical knowledge about herbicides; C6: Lack of knowledge about use of appropriate nozzle; C7: Moisture unavailability at the time of application; C8: Lack of information on method of herbicide application; C9: Lack of knowledge about use of sprayer; C10: High cost of herbicides; C11: Less risk bearing capacity about new technology

Figure 3.

the awareness level of farmers. Whereas, technical knowledge on use and application of herbicides decides the awareness level of farmers on herbicides. The study reported the constraints such as risk associated with the use of herbicides as major constraint for non-adoption of chemical method of weed control. Further, other main constraints were lack of technical knowledge about herbicides; lack of awareness about Improved Weed Management technologies; Lack of knowledge about the precautions to be followed during spray.

REFERENCES

Adesina AA and Forson JB. 1995. Farmers' perceptions and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics* **13**(1): 1–9. https://doi.org/10.1016/0169-5150(95)01142-8

Chauhan BS, Matloob A, Mahajan G, Aslam F, Florentine SK and Jha P. 2017. Emerging challenges and opportunities for education and research in weed science. *Frontiers in Plant Science* **8**: 1537. doi: 10.3389/fpls.2017.01537

Culpepper AS, Flanders JT, York AC and Webster TM. 2004. Tropical spiderwort (*Commelina benghalensis*) control in glyphosate-resistant cotton (*Gossypium hirsutum*). *Weed Technology* **18**: 432–436. https://doi.org/10.1614/WT-03-175R

Debrah SK. 1994. Socio-economic constraints to adoption of weed control techniques: The case of Striga control in the West African semi-arid tropics. *International Journal of Pest Management* **40**(2): 153–158. https://doi.org/10.1080/09670879409371874

Gharde Y, Singh PK, Dubey RP and Gupta PK. 2018. Assessment of yield and economic losses in agriculture due to weeds in India. *Crop Protection* **107**:12–18. https://doi.org/10.1016/j.cropro.2018.01.007

Gianessi LP. 2013. The increasing importance of herbicides in worldwide crop production. *Pest Management Science* **69**:1099–1105. https://doi.org/10.1002/ps.3598

Hall LM, Beckie HJ, Low R, Shirriff SW, Blackshaw RE, Kimmel N and Neeser C. 2014. Survey of glyphosate-resistant kochia (*Kochia scoparia* L. Schrad.) in Alberta. *Canadian Journal of Plant Science* **94**(1): 127–130. https://doi.org/10.4141/cjps2013-204

Liebman M, Baraibar B, Buckley Y, Childs D, Christensen S, Cousens R, Eizenberg H, Heijting S, Loddo D, Merotto A Jr, Renton M and Riemens M. 2016. Ecologically sustainable weed management: How do we get from proof-of-concept to adoption? *Ecological Applications* **26**(5): 1352–1369. https://doi.org/10.1002/15-0995

Mhlanga B, Cheesman S, Maasdorp B, Muoni T, Mabasa S, Mangosho E and Thierfelder C.2015. Weed community responses to rotations with cover crops in maize-based conservation agriculture systems of Zimbabwe. *Crop Protection* **69**: 1–8. http://dx.doi.org/10.1016/j.cropro.2014.11.010

Muoni T, Rusinamhodzi L and Thierfelder C. 2013. Weed control in conservation agriculture systems of Zimbabwe: Identifying economical best strategies. *Crop Protection* **53**: 23–28. https://doi.org/10.1016/j.cropro.2013.06.002

Oerke EC and Steiner U. 1996. Abschtzung der Ertragsverlusteim Maisanbau. pp. 63–79. In: *Ertragsverluste Und Pflanzenschutz - Die Anbausituation Fr Die Wirtschaftlich Wichtigsten Kulturpflanzen*. German Phytomedical Society Series, EugenUlmerVerlag, Stuttgart.

Rogers EM. 1983. Diffusion of Innovations. IIIrdedn. The Free Press, Collier Macmillan, New York, London, 453 p.

Rajashekar B, Sudharani V, Neema Parveen SK and Shivacharan G. 2017. Knowledge of farmers about integrated weed management (IWM) practices in major crops. *International Journal of Farm Sciences* **7**(1): 33–36.

Ramesh K, Matloob A, Aslam F, Florentine S and Chauhan BS. 2017. Weeds in a changing climate: vulnerabilities, consequences, and implications for future weed management. *Frontiers in Plant Science* **8**: 95. doi: 10.3389/fpls.2017.0009531

Singh PK and Gharde Y. 2020. Adoption level and impact of weed management technologies in rice and wheat: Evidence from farmers of India. *Indian Journal of Weed Science* **52**(1): 64–68. http://dx.doi.org/10.5958/0974-8164.2020.00011.8

Singh PK, Gharde Y and Choudhary VK. 2018. Adoption of integrated weed management practices correlates with farmers' profile characteristics. *Indian Journal of Weed Science* **50**(1): 69–71. http://dx.doi.org/10.5958/0974-8164.2018.00015.1

Swanton CJ, Nkoa R and Blackshaw RE. 2015. Experimental methods for crop–weed competition studies. *Weed Science* **63**: 2–11. doi: 10.1614/WS-D-13- 00062.1

Udensi UE, Tarawali G, Ilona P, Okoye BC and Dixon AGO. 2012. Adoption of chemical weed control technology among cassava farmers in South Eastern Nigeria. *Journal of Food, Agriculture and Environment* **10**(1): 667–674.