

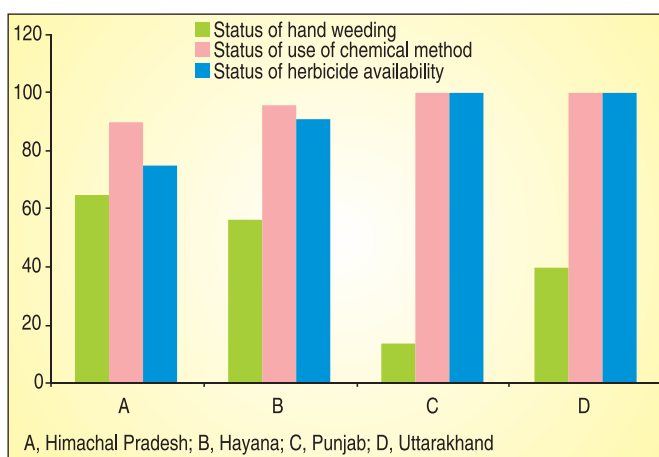
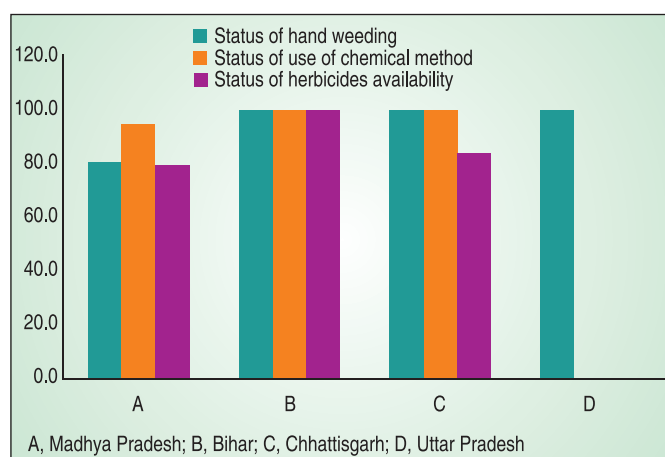
Adoption of weed management technologies by farmers in India

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India is the second most populous country in the world with population of about 1.35 billion and is expected to touch 1.7 billion by 2050. Thus, population detonation during the last few decades has put massive pressure on crop production, imposing the farming community to intensify agriculture to achieve food demands of the population. Therefore, to avoid any food starvation in future and feed the increasing population, food production must increase by 70%. The challenge is critical in view of the decreasing natural resources, adverse effect of climate change on crop productivity, livelihood security of the farmers and environment. High fluctuation in agricultural productivity and thereby farm income are causing a detrimental effect on the interest in farming and forcing farmers to leave the farming especially younger group. To remove the disparity between income of the farmers and workers in non-agricultural profession, the Hon'ble Prime Minister of India has announced to double the farmers' income by 2022. This is possible through increasing agricultural productivity, reducing cost of production and crop losses due to various harmful weeds and pests.

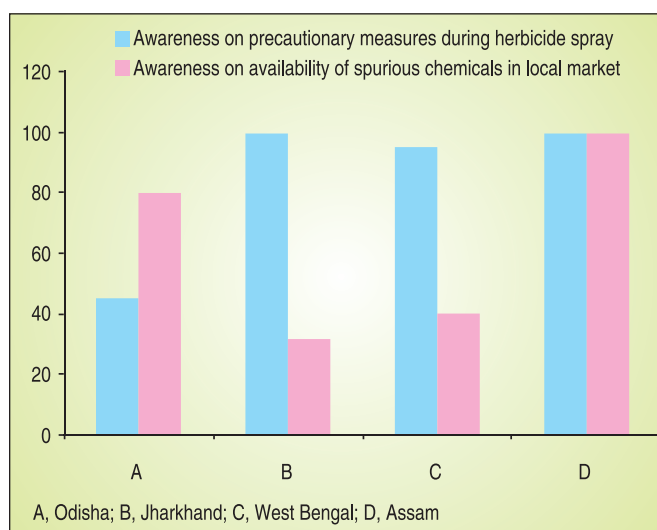
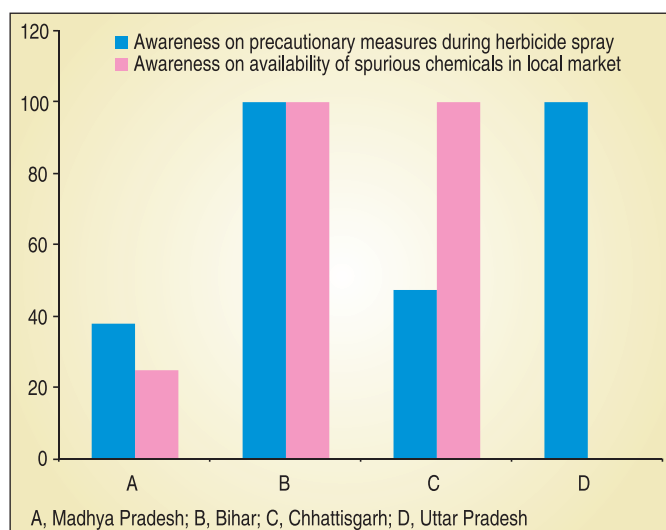
Key words: Farmers, Management, Technologies, Weed



A major constraint causing huge reduction in crop yields through competition and allelopathic interactions. In present-day agriculture, intensity of weed and behavior, frequently change due to intensive management practices, climate change, and ecological shift. Currently, in India, *Parthenium hysterophorus*; *Phalaris minor*;

Leptochloa chinensis; *Echinochloa* spp.; weedy rice; *Lantana camara*; *Chromolaena odorata*; *Mikania micrantha* are some of the major weeds of concern. Weed management in India is important to achieve desired crop productivity by minimizing yield losses due to weeds and to lessen other adverse effects of weeds in different ecosystems. In spite of the progress made in

developing weed management technologies for different crops and cropping systems, weeds continue to be a concern in varying ecosystems. Non-judicious use of chemicals for weed control, lack of knowledge on the impact of climate change on weeds, herbicide resistance in weeds, lack of information on integrated weed management, management of alien invasive weeds, unavailability of



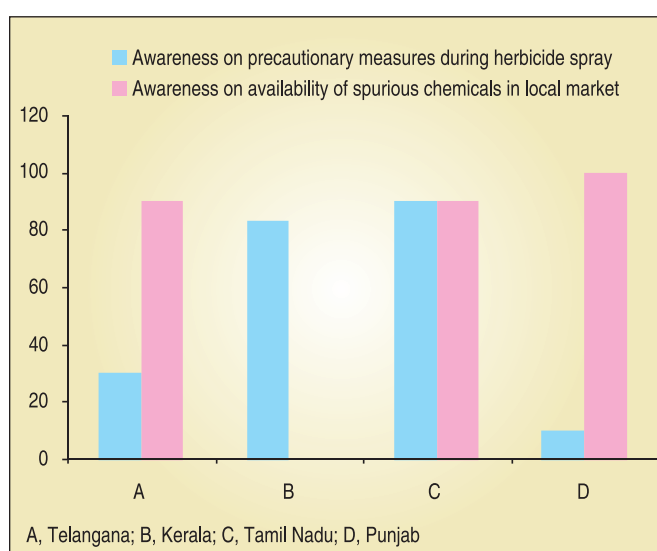
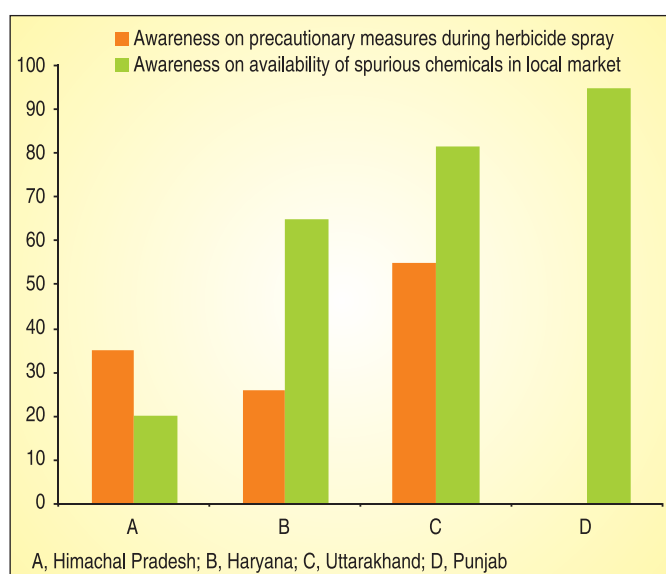
labour and machine-driven tools, weed management in small farms, lack of information on weed biology and weed shifts etc., are the real challenges in current Indian weed research.

Tillage has been used as an effective weed management tool since ancient times. It is very effective in suppressing weed, as many types of modern cultivators and weeders are enabling mechanical weed management. The introduction and adoption of no-till/minimum-till systems using herbicides proved that tillage is not as essential for crop production as it is for weed control. Some important mechanical weed-management tools are rotary hoe, rotavator, power tiller, rod weeder, cultipacker, spring-tine harrow, rototiller, finger weeder, torsion weeder, brush weeder, spike-tooth

weeder, and pneumatic weed blower. It was proved that weed dynamics are affected substantially by tillage systems. However, the respective efficiency of these tools declined with increasing density of weeds.

In a conservative estimate, it was found that nearly 9 billion person-days of labour would be required for hand-weeding the India's crop fields adequately. In reality, hand-weeding in India has been insufficient which has resulted enormous crop losses. In a regional survey, it was reported that hand-weeding was never performed in 15 to 30% of the fields of all major crops whereas less than half of the fields were hand-weeded once. However, more than 40% of the fields were hand-weeded for the first time after the critical period of first 36 days after sowing of the crops. In developed countries, rapid migration

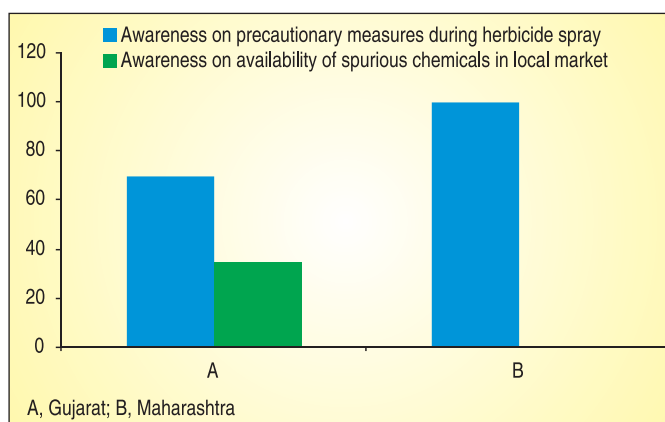
of population from agriculture has occurred to involve in profitable non-agricultural occupations, largely driven by mechanization and use of synthetic pesticides; the same is also happening in India. The Government of India Programmes live Mahatma Gandhi National Rural Employment Guarantee Act has generated labour shortages for hand-weeding in India because guaranteed employment and wages generated under this scheme have outpaced regular pay, thus making hand-weeding an unsustainable practice in the country. In recent years a shortage of labour was occurring on rural farms. Therefore, herbicides are being increasingly used by the farmers to overcome the problem of shortage of labour as well as to reduce the cost of production. Considering the diversity of weed problem and agro-



ecosystems, single method of weed control could not reach the desired level of efficiency under all situations. Thus, integrated weed management has been recommended as a viable and long-term management technique.

In past, several studies were conducted on adoption and impact of new weed management technologies, but few are accomplished especially on adoption and the impact of integrated weed management on farmers' fields. Hence, it is important to find out the prevailing level of knowledge and extent of adoption of integrated weed management practices by the farmers, and also to identify the constraints /limitations faced by them in adoption of integrated weed management practices. The Directorate of Weed Research took initiatives to demonstrate the conservation agriculture technology among farming community for sowing of wheat and greengram for the first time under on-farm research programme during 2012 in central India and in the Jabalpur district. The reports showed that the farmers' were not aware about conservation agriculture system which mainly involves no plowing and retaining the standing crop residues in the field. After introduction of zero-till technology on farmers' fields, it was observed that weed population in the conservation agriculture on-farm research trials was less compared to other field trials in which the land was prepared by conventional cultivator and harrow. The herbicides used in these on-farm research trials, viz. glyphosate and clodinafop + metsulfuron were chosen on the basis of the weed flora prevailing in the concerned fields. The herbicide effectively controlled the weed flora and increased yield of wheat as compared to the fields cultivated by conventional practice with no weed control measures. Thus, the crop performed better and produced 4.0-4.5 tonne/ha grain yield under conservation agriculture than the conventional practice (2.4-3.0 tonne/ha).

The successful demonstration of this technology was realized by



following the principles of 'learning by doing' and 'seeing is believing' in a participatory mode. After the successful introduction of this technology, area under zero tillage has been rapidly increasing and farmers stopped burning the residues of previous crop. The technology adoption by farmers is very encouraging and the performance of this technology has become a household discussion amongst the farmers of this locality. This conservation agriculture based technology has made significant impact on farmers of Jabalpur region. The farmers showed positive attitude about this technology. Saving time, cost, fuel during land preparation, labour and the overall profitability gains showed positive change in the attitude of farmers towards this technology. However, efforts should be made to include the non-chemical methods like residue management, solarization, crop rotation, intercropping, cropping systems, crop diversification and integrated weed management to conserve natural resources and achieving sustainable production in dryland agriculture.

Adoption of weed management technologies

Adoption of integrated weed management integrated weed management greatly influenced by the knowledge level of the farmers. Knowledge level gets improved with education, training, farming experience, extension contacts and innovativeness. Through many studies, it was observed that **age** has negative effect on adoption of integrated weed management technologies as old age farmers with

more farming experience are late adopters of new technologies. On contrary to this, young farmers showed interest towards new technologies and ready to take risk to gain higher profit

although they have less farming experience. Similarly, education level plays vital role and has positive effect on adoption level of the integrated weed management practices. Experience also influences the adoption level of integrated weed management at different stages of crop. Capacity building through trainings, field demonstrations, and follow up visits may also increase the knowledge level of farmers which ultimately influence the adoption level of farmers.

Study conducted by Directorate of Weed Research, Jabalpur on adoption of weed management technologies indicated that majority of the respondents in the study area had medium level of adoption irrespective of the crop. Among all the respondents, medium level of adoption were noticed among 56, 49, 50 and 55% farmers associated with rice, soybean, greengram and wheat crops, respectively. Correspondingly, high level of adoption was observed in 27.5, 19.3, 26.3 and 25.0% rice, soybean, greengram and wheat growers, respectively. Application of post-emergence herbicides was the most popular among farmers (52.7%), followed by application of pre-emergence herbicides with one hand weeding hand-weeding. The adoption level of only one hand-weeding and application of pre-emergence herbicide only were the next most prevalent and adopted weed management practices by the farmers irrespective of crops. However, use of manual weeder (wheel hoe) followed by 1 hand-weeding was the least preferred (12.5%) weed management practice among all.

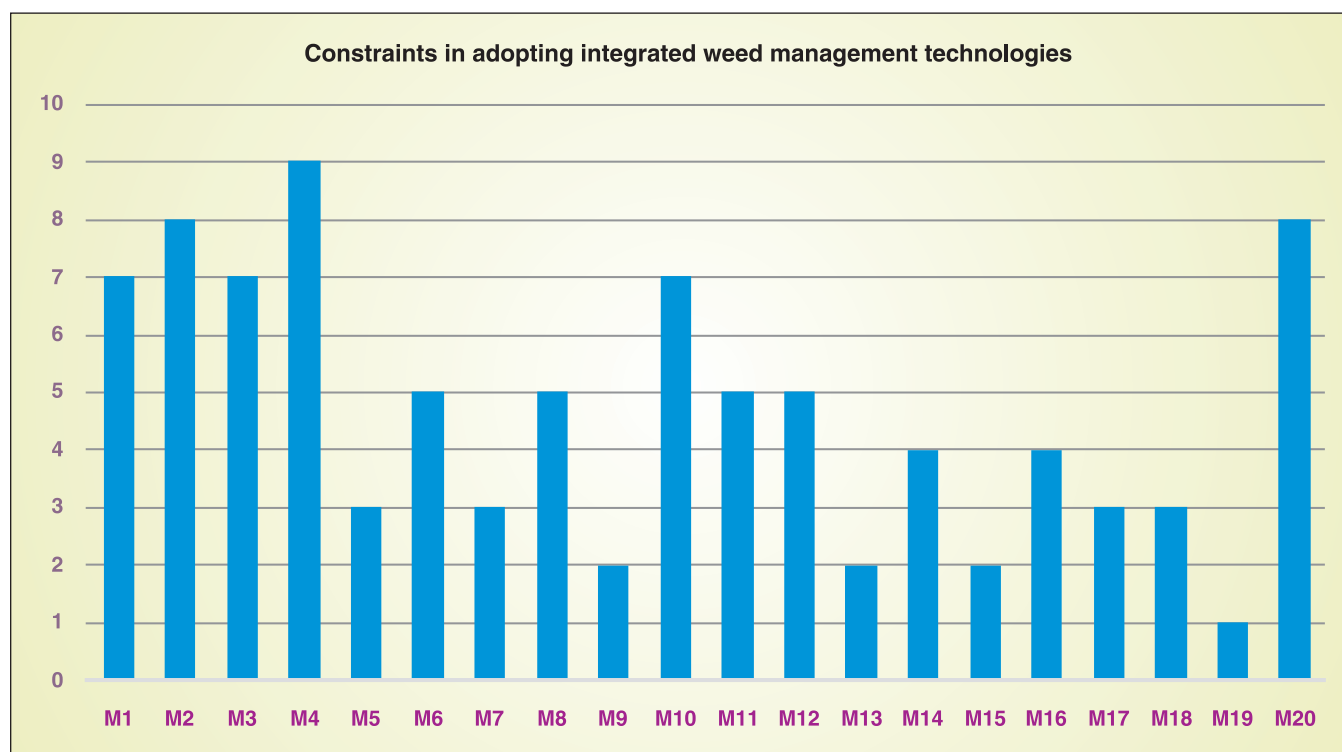
Lack of awareness about integrated weed management technologies	M 1
Lack of proper technical knowledge about herbicides	M 2
Unavailability of herbicides	M 3
High cost of herbicides	M 4
Social fear about use of herbicides	M 5
Less risk bearing capacity about new technology	M 6
Fear about residual effect on next crops	M 7
Supply of spurious/adulterated material	M 8
Spraying of herbicides is very tedious and complex job	M 9
If anything happened wrong due to use of herbicide, there is no to recouped the crop	M 10
Lack of information on recommended dose of herbicides	M 11
Lack of information on time of herbicide application	M 12
Moisture unavailability at the time of application	M 13
Lack of information on method of herbicide application	M 14
Lack of knowledge about use of sprayer	M 15
Lack of knowledge about use of appropriate nozzle	M 16
Lack of knowledge about quantity of water used for spray	M 17
Lack of knowledge about the precautions during spray	M 18
Resistance of weeds to herbicides, if any	M 19
Lack of technical knowledge for preparing of mixture of two herbicides for effective broad spectrum weed control and Time/labour saving?	M 20

Studying the relationship between profile characteristics and adoption level of integrated weed management practices in rice, it was observed that experience in farming, extension contact and input availability influenced the adoption level significantly at 5% level of significance, whereas, training and innovativeness affected significantly at 1% level of significance. However, age, farm size, education, mass media exposure, information seeking behaviour, farm mechanization

status, risk orientation and labour availability showed no effect on adoption. In soybean, all factors influenced the adoption level at 1% level of significance except farm size, risk orientation and labour availability. Also, in greengram, age, farm size and extension contact influenced the adoption level significantly at 5% level of significance and education, training in integrated weed management, information seeking behaviour and innovativeness affected at 1% level of

significance. Though, farming experience, mass media exposure, farm mechanization status, risk orientation, input availability and labour availability had no effect on adoption. Likewise, in wheat, extension contact and risk orientation affected the adoption level at 5% level of significance and age, education, farm size, mass media exposure, information seeking behaviour, innovativeness and input availability influenced the adoption level at 1% level of significance. However, farming experience, training in integrated weed management, farm mechanization status and labour availability showed no impact on adoption.

A survey conducted in 4 Mandals of Mahaboobnagar of Telangana revealed that majority of the farmers had medium level of knowledge irrespective of crop. A very positive and significant relationship was also found between level of knowledge of respondents on integrated weed management practices of rice, cotton, groundnut and chili crops with other variables such as age, education, extension contact as well as with innovativeness. Medium level of adoption in all crops followed by high and low levels in rice and cotton



Higher score denotes the important constraint than lower one

and low and high in groundnut and chili crop. Possible reason for this might be the predominant cultivation of cotton and rice crops which require weed control measures at different stages of crop production. Hence, to increase their knowledge levels, capacity building through training programmes and demonstrations were required. As discussed earlier, this study also confirmed that age and education are the main factors affecting the knowledge and adoption of new technologies including weed management options.

Similar study was carried out in four talukas of Parbhani district with sample size of 120 farmers involved in growing soybean crop. The study revealed that respondents were having medium level of knowledge about integrated weed management practices. Different factors such as education, land-holding, annual income, extension contact, sources of information, market and risk orientation had significant impact on knowledge of integrated weed management practices. Whereas, farming experience and occupation did not show any statistical significant impact on knowledge of integrated weed management.

A study was conducted by

Directorate of Weed Research in different regions of India to assess the impact of weed management technologies. Study revealed that very few agencies viz. centres of All India Coordinated Research Project on Weed Management at different State Agricultural Universities,

demonstrations conducted by these centres, Krishi Vigyan Kendra, TV/radio/newspaper/literature are responsible for dissemination of weed management technologies. Other extension functionaries e.g. State Department of Agriculture, Non-Governmental Organizations are still in infant stage to start work on dissemination of weed management technologies. It was reported that in rice, wheat, blackgram, greengram herbicides are being used for weed control especially the post-emergence herbicides at farmers' level. Most of the farmers which grow vegetables are still using hand-weeding as weed control methods and thus avoid the use of chemicals in their vegetable farms. Farmers suggested to improve the extension services on weed management. They suggested to improve the quality of information, increase the frequency of the demonstration in the farmers' field to increase the awareness among them on weed management technologies

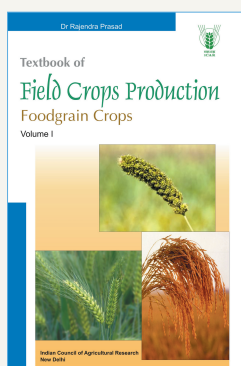
and provide information at requisite time.

SUMMARY

Adoption of weed management practices at farmers' fields varies as per the resource availability. Various reasons such as lack of knowledge and skill, non-availability of herbicides, spray equipment, technical know-how, climatic and social-economic conditions, poor extension mechanism etc. are hindrance on adoption. Non-adoption of weed management practices leads to cause heavy yield penalty. Therefore, there is need to reform the system to enable farmers to use low-cost technologies which are effective and acceptable in their situation. Efficient and effective methods of weed control, that are not only efficient but are also cost-effective, are needed as they invariably ensure higher crop productivity and eventually increase the net returns of the farmers. There are opportunities which would eventually increase the livelihood security of the farmers.

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TECHNICAL SPECIFICATIONS

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