



**ORIGINAL RESEARCH PAPER**

**Agricultural Science**

**ADOPTION OF HERBICIDE TECHNOLOGY AMONG PADDY AND SUGARCANE FARMERS**

**KEY WORDS:** Adoption, Herbicide, Paddy and Sugarcane.

**P. Punitha**

Department of Agricultural Extension, Faculty of Agriculture, Annamalai University, Annamalainagar-608 002, Tamil Nadu.

**D. Vengadesan\***

Department of Agricultural Extension, Faculty of Agriculture, Annamalai University, Annamalainagar-608 002, Tamil Nadu. \*Corresponding Author

**ABSTRACT**

A research study was conducted on 120 farmers including sixty paddy farmers and sixty sugarcane farmers from five villages of Jayankondam block of Ariyalur district to ascertain the adoption level of farmers about the herbicide usage by the paddy and sugarcane farmers. The results revealed that majority of the paddy farmers had low level of adoption while nearly half of the sugarcane farmers had medium level of adoption on utilization of herbicide technology in order to control weeds effectively and economically.

**INTRODUCTION**

Paddy is the world's most important staple food crop for about half of the humankind on the planet, while sugarcane is one of the main sources of sugar. In India, paddy is cultivated in 43 Mha with production of 112 million tons (Mt) of milled rice. Primarily a kharif crop, it is cultivated round the year in one or the other parts of the country. The crop is grown in highly diverse conditions ranging from hills to coasts. Particularly in Tamil Nadu, rice is cultivated over an area of 2.11 million hectares. However, the average productivity of rice (2.6 t/ha) is still well below the world average. Similarly, sugarcane is cultivated over an area of 4.25 million hectares in India with an annual production of 359 million tonnes (Singh et al., 2019). Though sugarcane occupies less than two percent of India's cultivated area, it is one of the most important non-food grain crops. It contributes to about seven per cent of the gross value of agricultural output. Uttar Pradesh has largest (>50%) area under sugarcane cultivation in the country while Tamil Nadu stands first on sugarcane productivity with 100t/ha. Nearly: 25 million farmers are engaged in the cultivation of sugarcane in the country and there are about 865 sugar factories spread all over the country. The production of sugarcane during 2017-18 is also higher by 11.19 million tonnes than the average sugarcane production of 342.04 million tonnes. With a significant increase by 47.16 million tonnes over 2016-17, total production of Sugarcane in the country during 2017-18 is estimated at 353.23 million tonnes. Economic losses due to weeds in Indian agriculture were estimated as INR 1050 billion per annum (NRCWS, 2007; Varshney and Prasad Babu, 2008). Weeds and crops compete for the same resources of nutrients, water, space and light for growth and development and further contribute around 45% of crop yield loss (Koravet al., 2018). Weeds are generally hardy species having fast growth, deep root system and capable of competing very efficiently with cultivated crops for the available resources and adversely affect the crop growth and yield. The major pest weed causes 12.5 per cent yield losses in rice whereas insect 9.5 per cent and disease 6.5 besides other pests 4.5 per cent. Severe weed problem and phasic emergence of weeds is identified as one of the serious issues in both rice as well as sugarcane cultivation ecosystems. In transplanted summer rice, the weed density and biomass are normally higher than that of the kharif rice. Moreover, as the crop was grown following SRI methodology, the more weed competition was observed as usually because of favourable low moisture status and suitable temperature under field condition. The higher density and biomass of the rice associated weed *Echinochloaformosensis* and others like *Leersiahexandra*, *Paspalum vaginatum*, *Cyperus difformis*, *Fimbristylisdichotoma*, *Ammaniabaccifera* and *Ludwigiaoctovalvis* were higher over the semi aquatic weeds like *Monochoriahastataefolia* and *Marsilea quadrifolia* due to

use of alternate wetting and drying situation in the summer rice field. The yield reduction in rice due to weeds varies up to 70 per cent (Ghosh et al., 1994).

Weeds cause 12 to 72 per cent reduction in cane yield depending on the flora, intensity and stages of weed competition (Johari and Singh, 1991). Wider row spacing and slow initial growth phase of sugarcane resulted in higher weed competition and more than 200 weed species have been reported to infest the sugarcane field, of which 30 are of economically important. The composition of weed species varies depending upon the climate condition, soil type, cropping systems followed and crop management practices including weed control. If weeds are not controlled adequately in the initial per cent stages, sugarcane yield losses could be anything between 172 and 354 tha. During germination and until the development of crop canopy, i.e., the initial 60-120 days after planting weeds have to be suppressed to avoid competition during the grow stage (Singh et al., 2018a&b).

- Women labourers are hired in large number for weed control in rice. Weed control through hand weeding using labour force is considered as tedious time consuming and expensive practice. Recently several chemical herbicides are evolved as alternate strategies to eradicate weeds easily in rice and sugarcane cultivation.
- Herbicide share in the total pesticide consumption in India is only around 12 per cent whereas the same is 45 per cent globally. This is because of fragmented land holding and availability of family labour to weed one's field. Further, farmers don't recognize weeds as major pest because of their endemic and hidden injury impacts. The herbicide use is low in general, probably due to lack of awareness and knowledge production of rice has increased by 1.31 million tonnes than the production of 109.70 million tonnes during 2016-17. It is also higher by 4.71 million tonnes than the five years' average production of 106.29 million tonnes. By considering the above information, present study was carried out with the followingspecific objectives.

1. To study the extent of adoption of herbicide technology among paddy and sugarcane farmers
2. To study the constraints faced by the paddy and sugarcane farmers in adoption of herbicide technology.

**MATERIALS AND METHODS**

The present study was carried out at Jayankondam block of Udayarpalayam taluk, Ariyalur district of Tamil Nadu. Data

were collected from 120 farmers by personally interviewing the respondents with the help of structured pre-tested interview schedule. Data thus collected were subject to simple analysis such as frequencies and percentage and the results emerged have been interpreted and presented.

**RESULTS AND DISCUSSION**

**1. Extent of adoption of herbicide technology among paddy and sugarcane farmers**

Knowledge generally leads to adoption. Among the ten items of herbicide technologies identified for the study, six items that could be observed for adoption were selected for studying extent of adoption. The results on extent of adoption of the six items of recommended herbicide technology are presented in Table 1.

**Table 1. Distribution of paddy and sugarcane farmers based on the extend of adoption of herbicide technology n=120**

S. No.	Category	Paddy Farmers		Sugarcane Farmers	
		No.	Per cent	No.	Per cent
1.	Low	38	63.33	21	35.00
2.	Medium	17	28.33	28	46.67
3.	High	5	8.34	11	18.33
Total		60	100	60	100

The Table 1 indicates that majority of the paddy farmers (63,33 per cent) had low level of adoption. This may be due to the reason that transplanted rice suffers less due to weeds because of stagnated water and the cost-benefit ratio for weed control has not been recognized to be very attractive by farmers.

Nearly half the sugarcane farmers (46.67 per cent) had medium level of adoption. It may be due to the fact that the sugarcane farmers get the herbicide and technical advice from the extension staff of Sugar Mills that enhances adoption.

**Item-wise adoption of herbicide technology among paddy and sugarcane farmers.**

The results on distribution of paddy and sugarcane farmers according to their adoption in respect of each of the six items of herbicide technology are furnished in Table 2.

**Table 2. Item-wise adoption of herbicide technology among paddy and sugarcane farmers.**

S. No.	Adoption Items	Paddy Farmers		Sugarcane Farmers	
		No.	Per cent	No.	Per cent
1.	Use of pre-emergence herbicides	30	50.00	55	91.67
2.	Use of post-emergence herbicides	2	3.33	13	21.67
3.	Method of application	30	50.00	53	88.33
4.	Time of application	12	20.00	35	58.33
5.	Type of nozzle	22	36.67	57	95.00
6.	Quantity of spray fluid /sand mix	5	8.33	21	35.00

**Item-wise adoption of herbicide technology among paddy farmers**

The Table 2 indicates that fifty per cent of the paddy farmers adopted pre- emergence herbicide. This may be due to the efforts of extension workers to popularize pre-emergence herbicides. As the extension workers do not link the supply of

herbicide along with advice only 50.00 per cent of farmers would have adopted the technology.

- Only 3.33 per cent of paddy farmers adopted post-emergence herbicides. Limited choice of post-emergence herbicides, and fear over crop injury deterred many of the paddy farmers from adopting post-emergence herbicides.
- Method of application was known to 50.00 per cent of paddy farmers. This may be due to extension efforts.
- Twenty per cent of the paddy farmers adopted herbicides at correct time. This may be due to cost and availability of herbicides and lack of awareness on the need to stick on to time of application.
- More than one-third of paddy farmers (36.67 per cent) adopted correct type of nozzle. As the paddy farmers usually depend on skilled labourers employed for spraying, the adoption of correct type of nozzles was left to the skilled labourers. It also indicates the need for enlightening farmers and skilled labourers on this technological item.
- Right quantity of spray fluid/ sand mix was adopted by only 8.33 per cent of paddy farmers. This again is due to the unhealthy practice of skilled labourers who prefer to spray the area faster with less spray fluid.

**Item-wise adoption of herbicide technology among sugarcane farmers**

The Table 2 indicates that a vast majority (91.67 per cent) of sugarcane farmers adopted pre-emergence herbicides. Because they want to get their target yield through the avoidance of weed growth. Further sugarcane farmers get herbicides and technical advice from the extension staff of Sugar Mills. This is the reason for higher adoption.

More than one-fifth (21.67 per cent) of the sugarcane farmers adopted post- emergence herbicides. Lack of interest, knowledge, preference to adopt hand weeding may be the reason for this low level of adoption. Limited choice and cost of post-emergence herbicides, fear over crop injury deterring many of the sugarcane farmers from adopting post-emergence herbicides might be the reasons for high non-adoption.

Majority of the sugarcane farmers (88.33 per cent) adopted correct method of application. Sugarcane farmers had knowledge about correct method of application and its benefits through extension agents and mass media. This may be the reason for high adoption.

More than fifty per cent of sugarcane farmers (58.33 per cent), adopted correct time of application. High level of income, recommendation by extension agents and herbicides available from Sugar Mill staff may be the reason for the result reported.

A vast majority (95.00 per cent) of sugarcane farmers adopted correct type of nozzle. Awareness of correct type of nozzles, and their benefits may be the reason for, adoption. Usually, sugarcane farmers watch the type of nozzle selected by skilled labourers. Farmers also prefer correct type of nozzle to control weed through uniform application.

Right quantity of spray fluid was adopted by 35.00 per cent of sugarcane farmers. This again is due to unhealthy practice of skilled labourers who prefer to spray the area faster with less spray fluid.

**Constraints faced by the paddy and sugarcane farmers in adoption of herbicide technology**

This section deals with the constraints as experienced by the paddy and sugarcane farmers for their non-adoption of herbicide technology in paddy and sugarcane cultivation. The salient findings are given in Table 3.

**Table 3. Constraints of paddy and sugarcane farmers on the adoption of herbicide technology**

n=120

S. No.	Constraints	Paddy Farmers		Sugarcane Farmers	
		No.	Per cent	No.	Per cent
1.	Non-availability of herbicides	43	71.67	30	50.00
2.	Inability to remember the quantity	50	83.33	20	33.33
3.	Lack of knowledge	43	71.67	15	25.00
4.	Lack of technical guidance	46	76.67	2	3.33
5.	Lack of adequate training	54	90.00	50	83.33
6.	High labour cost	46	76.67	13	21.67
7.	High herbicide cost	33	55.00	25	41.67
8.	Limiting finance	45	75.00	20	33.33
9.	Lack of interest	45	75.00	5	8.33

**i) Non-availability of herbicides**

About three-fourths (71.67 per cent) of paddy farmers reported non-availability of herbicide as the constraint. It was found that herbicides were not available locally in adequate quantity. This finding is supported by the findings of Renjini (2000).

Fifty per cent of the sugarcane farmers felt non-availability of herbicides in their locality. Farmers did not get herbicides at the time of application in their villages. This finding is supported by the findings of Patel *et al.* (1988).

**ii) Inability to remember the quantity**

Majority of paddy farmers (83.33 per cent) reported that they were unable to remember the quantity of herbicides recommended. Majority of the paddy farmers belonged to old age group and hence they were inability to remember the correct dose to spray fluid or sand mix for the adoption of herbicides. One-third (33.33 per cent) of sugarcane farmers felt difficult in remembering the quantity. Because, age old farmers easily forget the ratio for the preparation of prepare the spray fluid.

**iii) Lack of knowledge**

About three-fourths of the paddy farmers (71.67 per cent) reported that lack of knowledge was a constraint in adopting the herbicide technology. Majority of the respondents in the study area were not inclined to adopt recommended technology in their field due to lack of awareness of the benefits of herbicide technology. This finding is in conformity with the finding of Thyagarajan (1996). One-fourth of the sugarcane farmers (25.00 per cent) faced lack of knowledge as the constraint. This may be due to lack of involvement in extension activities. This finding is supported by the finding of Reddy and Reddy (1990).

**iv). Lack of technical guidance**

Lack of technical guidance was expressed by 76.67 per cent of paddy farmers. The farmers felt that technical guidance was not available from extension workers in time probably

due to the busy schedule of extension workers. This finding is in line with the findings of Kher (1991).

Negligible per cent of sugarcane farmers (3.33 per cent) felt lack of technical guidance as the constraint. Extension workers of Sugar Mills would have given guidance during their visits. This may be the reason for the result reported. This is line with the findings of Jayakrishnan (1984).

**v) Lack of adequate training**

Ninety per cent of paddy farmers reported lack of adequate training as the constraint. Most of the paddy farmers reported that farm labourers and farmers were not adequately trained. This finding. This finding is in line with the finding of Nagabhushanamet *al.* (1991). More than three-fourths (83.33 per cent) of sugarcane farmers felt lack of adequate training as the constraint. Cane assistants and extension officers had given training only on certain dimension. Further, there were no exclusive training programme conducted by extension personnel on herbicide technology. This is supported by the findings of Tantray and Nanda (1991).

**vi) High cost of labour**

High labour cost was the constraint faced by 76.67 per cent of the paddy farmers. Most of the respondents expressed that agricultural labourer demand higher wages irrespective of nature of work. This finding is in line with the finding Prasanna (1987).

More than one-fifths (21.67 per cent) of sugarcane farmers felt cost of labour was high for spraying of herbicides on their field. With the small and marginal holdings, it is quite natural that the demand was high. This finding is line with the findings of Chennagowda (1971).

**vii) High cost of herbicides**

More than half the proportion (55.00 per cent) of paddy farmers exposed that cost of herbicides was a constraint. Majority of the paddy farmers had low level of annual income. Hence, the cost of herbicide was considered a constraint.

More than forty per cent of the sugarcane farmers (41.67 per cent) felt high cost of herbicides as a constraint. Low and middle level income group farmers felt cost of herbicide as high. They could not get adequate quantity with their limited finance. It was the reason for the constraint.

**viii) Limiting finance**

Limiting finance was the constraint faced by 75.00 per cent of the paddy farmers. This may be due to the low level of annual income of the paddy farmers. This finding is in line with the findings of Uma (1992).

One-third of the sugarcane farmers (33.33 per cent) faced limiting finance as a constraint during application of herbicides. Cost of labour and herbicide are high for the sugarcane farmers in view of their financial status. This finding is supported by the findings of Sathasivam (1997).

**ix) Lack of interest**

Three-fourths of the paddy farmers (75%) felt lack of interest as a constraint in adoption. Majority of the paddy farmers were not ready to change from the usual cultural operations to the new herbicide application. They felt that hand weeding is better than herbicide application. This finding is supported by the finding of Sathasivam (1997).

Only 8.33 per cent of sugarcane farmers reported that they did not have interest to adopt the herbicides. They are probably the laggards.

**CONCLUSION**

Proper weed control should be done during the critical periods between 90-120 days after sprouting to avoid

potential 12-72% yield loss [7, 14, 28, and 29]. Manual weed control is applicable and commonly practiced in SSA due to relatively small farm sizes and poor knowledge on the use of herbicide among farmers. For better weed control, tillering and yield about 3-4 weeding is enough to keep weeds below economic threshold levels. Another strategy slowly gaining popularity in the region is the use of the herbicide (Otieno *et al.*, 2019). Examples of herbicides commonly used in sugarcane production include asulam, atrazine, metribuzin, glyphosate, pendimethalin, terbacil, diuron and hexazinone, etc. The use of herbicide is time economical compared to hand weeding and should, therefore, be encouraged among farmers as long as safety measures are considered. It is important to use less toxic herbicide products and have personal protective equipment whenever handling these chemicals to avoid human and ecological risks (Otieno 2019).

## REFERENCES

1. Anonymous, 2002. Agricultural statistics at a glance. 2002. Department of Agriculture and co-operation. Annual Report.
2. Das Gupta, S., B. Minten, N. C. Rao and T. Reardon. 2017. The rapid diffusion of herbicides in farming in India: Patterns, determinants and effects on labour productivity. *EJDR*. doi:10.1057/s41287-017-0091-6
3. Ghosh, R., B. C. Ghosh, A. J. Mitra and B. N. Mitra, 1994. Techniques of rice-cum-fish culture for increasing productivity in low lands. *Indian Farming*, 44 (4):23-26.
4. Gianessi, L.P. 2013. The increase importance of herbicides in worldwide crop production. *Pest Manag. Sci.*, 69:1099-1105
5. Johari, D. and R. C. Singh. 1991. Weeds of sugarcane losses due them and their control. *Bharatiya Sug.*, 16(3):33-39.
6. Oerke, E. 2006. Crop losses to pests. *J. Agr. Sci.*, 144:31-43.
7. Singh, P. and A. K. Tiwari (2014a) Sustainable sugarcane production. CRC Press, New Jersey.
8. Singh, A. and A. K. Tiwari (2018b) Mineral nutrition in plants and its management soil. In: Abbas Z, Tiwari AK, Kumar P (eds) Emerging trends of plant physiology for sustainable crop production, CRC Press, New Jersey, pp 281-296.
9. Strigh P, Singh SN, Tiwari AK, Pathak SK, Singh AK, Srivastava S, Mohan N (2019) Integration of sugarcane production technologies for enhanced cane and sugar productivity targeting to increase farmers' income: strategies and prospects. *Bio-tech*:9:48.
10. Korav S, Dhaka AK, Singh R, Premaradhya N and Reddy GC (2018) A study on crop weed competition in field crops. *Journal of Pharmacognosy and Phytochemistry*, 7(4):3225-3240.
11. Otieno HM. (2019) Pesticide training tool: A simplified guide for Agricultural Extension Officers and Farmers. *Asian Journal of Research in Crop Science*, 1-5.
12. Otieno HMO, Onduru GO and Okumu OO (2019) Improving Sugarcane (*Saccharum officinarum* L.) yields in Sub-Saharan Africa through the use of existing technologies: Sugarcane agronomy, *World Journal of Advanced Research and Reviews*, 03(02):065-065
13. Renjini, A.R. 2000. "Adoption of weed management practices in Alappuzha district in Kerala", Unpublished M.Sc. (Ag.) Thesis, Annamalai University, Annamalai nagar.
14. Patel, C.S., Kumar, S., Pathak, K.A. and B.S. Trivedi. 1998. "On-farm research on rice-problems and approaches by Indian Council of Agricultural Research Complex for North Eastern Hilly Region", Tamil Nadu Agricultural University News Letter, 11(3):1-4.
15. Thyagarajan, S. 1996. "Yield gap and constraints to high yields in rice at farm level", Unpublished Ph.D. Thesis, Annamalai University, Annamalai nagar.
16. Reddy, V.M. and S.V. Reddy. 1990. "A study on extent of adoption and reasons for non-adoption of paddy cultivation practices by the farmers of Guntur district in Andhra Pradesh", *The Andhra Agricultural Journal*, 37(2):157-162.
17. Kher, S.K. 1991. "Constraints in increasing rice production", *Indian Journal of Extension Education*, 27 (1&2):121-123.
18. Jayakrishnan, S. 1984. "Adoption of low cost technology among paddy growers" Unpublished M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.
19. Nagabushanam, K., Sridharaherle, P. and K. Balakrishna Rao. 1991. "Yield gaps in high yielding varieties of paddy", *Mysore Journal of Agricultural Sciences*, 25 (1):510-512.
20. Tantray, A.M. and R. Nandha. 1991. "Constraints in increasing rice production", *Indian Journal of Extension Education*, 27(1&2):124-126.
21. Prasannan, K.M. 1987. "Extent of adoption of messages by contact farmers in T&V system", Unpublished M.Sc. (Ag.) Thesis, Kerala Agricultural University, Thiruvananthapuram.
22. Chennagowda, M.B. 1971. "A study on the adoption of recommended paddy practices by farmers of Mandya district in Mysore state", Unpublished M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Bangalore.
23. Uma, K. 1992. "Yield -gap and constraints to high rice yields in Thanjavur district", Unpublished M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.
24. Sathasivam, A. 1997. "Awareness knowledge and adoption of bio-fertilizers in rice cultivation", Unpublished M.Sc. (Ag.) Thesis, Annamalai University, Annamalai Nagar.