RESEARCH ARTICLE

Effectiveness of Mole Drainage Technology for Reclamation of Waterlogged Soils for Crop Improvement and Farm Income in Maharashtra

B. T. Kolgane[1*], Swati Khandave[1], P. R. Patil[1] and S. S. Patil[1]

[1]College of Agriculture, Kolhapur, Maharashtra, India

ABSTRACT

Mole plough technology has proved as a viable and economically feasible alternative to improve the waterlogged and saline soils of canal command area of Sangli district of Maharashtra state. The low cost mole technology was demonstrated on 120 acres area of farmer's field from Sangli district during 2016-17 to 2018-19 under RKVY. In order to know the effect of mole technology, present research was undertaken with the objectives to study the knowledge about effect of mole technology and its adoption by beneficiaries, its effectiveness on soil health, yield and income of beneficiary and constraints in adoption of technology. The study was conducted in Miraj, Tasgaon and Palus tahsils of Sangli district purposively. A list of beneficiary farmers was obtained from Agricultural Research Station, K. Digraj, Sangli and total 120 respondents were seledted from list. The respondents were personally interviewed with structured schedule and data was analysed for the results. The major results of the study revealed that mole technology has shown effect on soil health, cent per cent respondents were known about that mole technology improved soil texture, decreased salt deposition, resulted in early field capacity. Study further revealed that cent per cent beneficiaries gained the knowledge about practice of trenching to drain out excess water also majority were having knowledge about use of organic manure and gypsum for management of water logged soils and more that half were adopting these practices. Farmers also known that mole technology needs more than 65 HP tractor, length of furrow should be 20 to 100 m and minimum distance between mole drain should be 4 meter. Further impact was observed on increase in yield and income level of sugarcane crop, change in average yield was observed 26MT and Rs. 78000/- was increased in gross income of the farmer. Therefore to popular the technology on large scale mole plough and high power tractor should be make available on custom hire basis.

Keywords: *Effectiveness, mole technology, waterlogged soils.*

OPEN ACCESS JOURNEL

Check for updates

Citation: B. T. Kolgane, Swati Khandave, P. R. Patil and S. S. Patil (2021). Effectiveness of Mole Drainage Technology for Reclamation of Waterlogged Soils for Crop Improvement and Farm Income in Maharashtra. *Chemical Engineering*. v02i04, 97-101. http://dx.doi.org/10.53709/CHE.2021.v02i04.017

DOI:
http://dx.doi.org/10.53709/CHE.2021.v02i04.017

Corresponding Author:
B. T. Kolgane
Kolganebt@gmail.com

Received on: August 10, 2021
Revised on: October 20, 2021
Accepted on: November 23, 2021

INTRODUCTION

Waterlogging is the condition arised due to heavy rainfall or over-irrigation and occurred in the form of natural flooding when underground water rises to surface level.It constraints plant growth and production ,affect the natural processes in the soil and result in a build-up of toxic substances in the soil thereby make the soil unproductive.

In India the area under salt-affected soils is about 6.73 million ha and in Maharashtra it accounts to 0.61 m ha, major states in India accounts for almost 75% of saline and sodic soils in the country.It would almost treble to 20 m ha by 2050 [1] if the soils health is not taken care.

Nearly 2.96 million ha lands are affected by the waterlogging and soil salinity problems spread across 16 states of the country. The annual crop production and monetary losses due to the salinity problem at the national level are 5.66 million tones and 80,000 million rupees. [2]. In Maharashtra, especially under irrigated conditions, cultivated area is affected due to water logging, soil salinity and sodicity problems. Also due to water-logging and excess accumulation of salts in the root zone crop growth and yield is affected adversly. The best example of this is in Maharashtra the productivity of sugarcane reduced from more than 150 t ha-1 during the initial stages of

introduction of irrigation to 50-60 t ha-1 after water logging and salinity of soil (Rathod *et al.,* 2011).The methods adopted for reclaiming the salt affected and waterlogged soils are mainly surface and subsurface drainage systems which are not economical to small and marginal farmers as it requires huge capital investment, wastage of land and frequent maintenance. [3,4]. In some areas, due to very low productivity and less income from waterlogged vertisols, farmers are putting their lands barren and working as farm labor on other farmer's field. The socio-economic status of these farmers are totally hampered due to problems of water logging and salinity of soil.

Therefore, land drainage research continued to be one of the major thrust areas of Agricultural research organizations in the country and needs to focus. [11, 12]

Therefore, it becomes necessary to provide economically feasible technology to the small and marginal farmers to improve the degraded and waterolgged soils. In this context, a viable alternate to pipe drainage could be mole drainage which is a pipeless and trenchless drainage system. In Maharashtra more than 80 percent farming community fall under small and marginal category where mole plough drainage technology could be easily adapted by the farmers without disturbing the natural recourses with proper ecological, economical balance. Taking this into account, scientists from Agricultural Research Station (ARS), Kasbe Digraj Sangli have successfully demonstrated low cost mole drainage technology on 120 acres area on farmer's field during 2016-17 to 2018-19. The fund of Rs.1400 per acre was allotted through RKVY-FF project since 2016-17 to 2018-19 for installation of mole drains. These mole drains were installed on 120 farmer's field of Sangli district through custom hire basis from high HP tractors holders (more than 65 HP).Considering this background it felt necessary to study the effectiveness of mole plough technology in the command area of Sangli district. The research was undertaken with the objectives to study the knowledge and adoption of low cost mole drainage technology ,its effectiveness on soil health,yield and income of beneficiary and constraints in adoption of technology.

MATERIALS AND METHODS

Sangli district from Maharashtra state was purposively selected as it comes under canal commands of the state and three tehsils *viz. Miraj, Tasgaon* and *Palus* were purposively selected as low cost mole drainage technology had been successfully demonstrated on farmers field in these tahsils to reclaim the waterlogged and saline soils. The list of farmers who had practiced mole plough technology was obtained from Agricultural Research Station, K. Digraj, Sangli. In all 120 technology adopters from these selected tehsils were purposively selected for the study. The respondents were interviewed with the help of pre-tested interview schedule. Simple percentage and frequency was calculated and data was analysed for the results. Effectiveness of mole plough technology was studied in terms of knowledge gained by the farmer regarding methods for identifying waterlogged soils and its management, adoption of mole plough technology by the farmer and its effect on soil health, yield and income of farmer.

RESULTS AND DISCUSSION

Regarding effectiveness of mole plough technology on soil heath all respondents stated that soil texture has been improved, decreased in salt deposition and field capacity has improved after use, followed by 79.17 per cent told that active plant root zone has been increased. Similar observations were reported by Tiwari and Goel [5]. Data regarding methods used for identifying water logged soils revealed that only 35.83 per cent were having knowledge and 17.50 per cent were using flowing water method. All the respondents were having the knowledge about draining out excess water for management of water logged soil and 61.67 per cent respondents were adopting that practices followed by use of gypsum @5MT/ha was used by 68.33 per cent respondents. Only 11.67 per cent respondents were having the knowledge about zero or minimum tillage but none of them adopted this technology.

Cent per cent farmers were awared about mole technology aspects *viz.* requirement of more than 65 HP tractor,length of furrow should be 20 to 100 meters and minimum distance between mole drain should be 4 meter. Majority (81.67 per cent) of the respondents were knowing that there should be 90 cm deep trench around field and 69.17 per cent respondents were adopting this technology for effective implantation.

It also equally important to study the effectiveness of mole technology on yield and income of major crop of the adopter farmers. After adoption of low cost mole plough technology ,the soil affected area brought under cultivation ,major crop grown in the prevailing area was sugarcane. Therefore effectiveness on yield and income level of the respondents of the sugarcane crop was studied and shown in the Table 2. The respondents found that after adoption of mole technology yield and income level of sugarcane crop has been increased. (Similar findings were reported by) [6,7,4].The change in minimum yield and maximum yield in sugarcane crop was 15 MT and 42 MT respectively after use of mole plough technology. Similar findings were reported by Dhakkad *et al.*[10]. Also the change in average yield was observed 26MT and Rs. 78000/- was

http://dx.doi.org/10.53709/ CHE.2021.v02i04.017

Table.1 Effectiveness of mole plough technology for reclamation of waterlogged soils

Sr. No.		Particulars	Knowledge		Adoption (n=120)		
			Yes	No	Complete	Partial	No
A	**Knowledge gained about effect of mole technology on soil health**						
	1	Increased in soil aeration and soil fauna	89 (74.17)	31 (25.83)			
	2	Increased active plant root zone	95 (79.17)	25 (20.83)			
	3	Improved soil texture	120 (100.00)	00			
	4	Adequate soil temperature	70 (58.33)	50 (41.67)			
	5	Decrease in salt deposition	120 (100.00)	00			
	6	Early field capacity	120 (100.00)	00			
B		**Practicewise knowledge and adoption of methods for identifying water logged soil**					
	1	Flowing water is observed in a pit of 40 cm depth	43 (35.83)	77 (64.17)	21 (17.50)	00	99 (82.50)
	2	Appearance of flowing water in perforated pipes dug at same depth	00	120 (100.00)	00	00	120 (100.00)
C		**Practicewise knowledge and adoption of management of water logged soils**					
	1	Draining out excess water by trenching along field	120 (100.00)	00	74 (61.67)	32 (26.67)	14 (11.67)
	2	Raised bed cultivation in affected area	65 (54.17)	55 (45.83)	21 (17.50)	13 (10.83)	86 (71.67)
	3	Avoid compaction of soil by controlling pass by movement	20 (16.67)	100 (83.33)	00	00	120 (100.00)
	4	Application of organic manures	74 (61.67)	46 (38.33)	53 (44.17)	21 (17.50)	46 (38.33)
	5	Adoption of minimum or Zero tillage technology	14 (11.67)	106 (88.33)	00	00	120 (100.00)
	6	High density planting to avoid land compaction	12 (10.00)	108 (90.00)	00	00	120 (100.00)
	7	Use of soil amendments					
		Gypsum @ 5 MT/ ha	82 (68.33)	38 (31.67)	65 (54.17)	17 (14.17)	38 (31.67)
	8	Dhaincha (In situ or green manuring)	60 (50.00)	120 (100.00)	24 (20.00)	00	96 (80.00)
D		**Knowledge and adoption of mole technology by the adopter farmers**					
		Land topography and physical properties					
	1	Clay content in soil more than 35 per cent	10 (8.33)	110 (91.67)			
	2	Land slope 1 to 1.5 per cent	04 (3.33)	116 (96.67)			
			Yes	**No**	**Complete**	**Partial**	**No**
	3	Moisture level at 40 to 75 cm depth near to 20 to 25 per cent	12 (10.00)	108 (90.00)			
	4	Availability of at least 90 cm deep trench around field	98 (81.67)	22 (18.33)	71 (69.17)	27 (22.50)	22 (18.33)
	5	Minimum distance between two moles - 4 meter	120 (100.00)	00	120 (100.00)	00	00
	6	Length of furrow depending on field length- 20 to 100 meters	120 (100.00)	00	120 (100.00)	00	00
	7	Tractor power requirement - more than 65 HP	120 (100.00)	00	120 (100.00)	00	00
	8	Speed of tractor while ploughing 1km /hr or less	37 (30.83)	83 (69.17)	12 (10.00)	108 (90.00)	00

*figures in parenthesis indicate percentages

http://dx.doi.org/10.53709/ CHE.2021.v02i04.017

increased in gross income of the adopter farmer.Net income after deducting expenditure of mole plough i.e. Rs.5000/- was Rs.73000/- per hectare. Similar results were reported by Rathod et al. [8] and Datta *et al.* [9].

It is revealed from Table 3 that cent percent respondents were focused the constraints of unavailability of mole plough at local level followed by lack of technical knowledge about soil amendments (93.3 per cent). Unavailability of high power tractors was also the major constraints faced by 91.7 per cent farmers.

It is observed from Table 4 that all the respondents suggested that subsidy for soil reclamation should be given followed by 96.67 per cent farmers suggested sugar factories should made outlet drains in their command area.95.83 per cent respondents suggested that Gypsum should be made available at primary credit co-operative society in required quantity.

Table 2. Effectiveness of mole technology on yield and income of the respondents for Sugarcane Crop

Sr. No.	Particulars	Before	After	Change observed
1	Minimum Yield Reported (MT/ha)	49MT	64 MT	15 MT
2	Maximum yield Reported (MT/ha)	96 MT	138MT	42 MT
3	Average Yield of Respondents (MT/ha)	68 MT	94 MT	26 MT
4	Gross Income /ha (Rs.)	204000	282000	78000
	Net Income (excluding mole expenditure Rs.5000/- ha.)			73000/-

Table 3. Constraints faced by the technology adopters

Sr. No.	Constraints	No. of sugarcane cultivators (n= 120)	Percentage
1	Unavailability of mole plough at local level	120	100.0
2	Unavailability of High power tractors	110	91.7
3	Underground Utility lines hampering plough depth	03	2.5
4	Lack of drainage facilities	100	83.3
5	Lack of technical knowledge regarding soil amendments	112	93.3
6	Unavailability of Gypsum	89	74.2
7	High cost of Gypsum	85	70.8

Table 4. Suggestions made by the technology adopters

Sr. No.	Particulars	No. of sugarcane cultivators n= 120)	Percentage
1	The Grampanchayat of affected village should purchase 3 to 4 ploughs and made available to needy farmers. The cost of mole plough is about 36000/- per plough.	98	81.67
2	Subsidy for soil reclamation should be given.	120	100.00
3	Training programmes should be organized on large scale in affected and prone areas.	67	55.83
4	Encroachments on natural drains along river basin should be removed.	56	46.67
5	Gypsum should be made available at primary credit co-operative society in required quantity	115	95.83
6	Agriculture department of Maharashtra state should provide subsidy for higher H.P tractors which is need for mole plough technology.	112	93.33
7	Hence, sugar factories should made outlet drains in their command area.	116	96.67

CONCLUSION

Cent percent farmers reported that adoption of mole plough technology helped to improve soil texture, decreased salt deposition and improved early field capacity of soil. Also it enabled to maintain proper soil aeration and adequate soil temperature which resulted an increase in active plant root zone. Moreover it also helped to increase yield and income of the farmers. Thus study can be concluded that there is need to popularize this low cost technology for its adoption on large scale. The mole plough and high power tractor (above 65 HP) should make available on custom hire basis or in subsidized rate for small and marginal farmers.

Competing interests

Authors have declared that no competing interests exist.

REFERENCES

[1] Sharma DK, et al. CSSRI vision 2050. Central Soil Salinity Research Institute, Karnal; 2014a.

http://dx.doi.org/10.53709/ CHE.2021.v02i04.017

[2] Sharma DK, Singh A. Salinity research in India-achievements, challenges and future prospects. Water and Energy International. 2015;58(6):35-45.

[3] Bundela D, Kaledhonkar MJ, Gupta SK, Mohan Lal. Cost estimation of sub-surface drainage systems for reclamation of waterlogged saline lands. Journal of Soil Salinity and Water Quality. 2016;8(2):131-143.

[4] Chinchmalatpure AR, Vibhute SD, Kaledhonkar MJ, Kad SV, Shrvan Kumar David Camus, Indivar Prasad, Kamra SK, Sharma PC. Performance Evaluation of Subsurface Drainage System under Waterlogged Saline Vertisols for sugarcane crop in ukai kakrapar canal command, Gujarat. Journal of Agricultural Engineering. 2020;57(3):248-258.

[5] Priyanka Tiwari, Arun Goel. An overview of impact of subsurface drainage project studies on salinity management in developing countries. Applied Water Science. 2015;7(2):13201-13229.

[6] Rao KVR, Kishore R, Singh R. Mole drainage to enhance soybean production in waterlogged Vertisols. J. Agric. Eng. 2009;46:54-58.

[7] Dhakad SS, Ramana Rao KV, Mishra KP. Effectiveness of mole drains for soybean crop in temporary waterlogged vertisols of Madhya Pradesh. Current World Environment. 2014;9(2):387-393.

[8] Rathod SD, Kamble BM, Kathmale DK. Effect of low cost mole drainage technology on yield of chickpea (*Cicer arietinum* L.) under waterlogged vertisols of Maharashtra, India. Journal of Applied and Natural Science. 2016;8(2):1035–1038.

[9] Datta KK, Tewari L, Joshi PK. Impact of subsurface drainage on improvement of crop production and farm income in northwest India. Irrigation and Drainage Systems. 2004;18:43–55.

[10] Dhakad SS, Ambawatia GR, Gayatri Verma, Santosh Patel, Ramana Rao KV, Sangiv Verma. Performance of mole drain system for soybean (*Glycine max*) -wheat (*Triticum aestivum*) cropping system of Madhya Pradesh. Int. J. Curr. Microbiol. App. Sci. 2018;7(02):2107-2112.

[11] Kaledhonkar MJ, Kamra SK, Sharma DP. Drainage measures for control of waterlogging in semi-arid regions. In: Proceedings 9th national symposium on hydrology, Amritsar, 26-27th Nov. Amritsar. 1998;97–104.

[12] Kaledhonkar MJ, Gupta SK, Singh G. An overview of research, development, opportunities and challenges for subsurface drainage in India. In: 60th international executive council meeting & 5th Asian regional conference, New Delhi, India; 2009.

http://dx.doi.org/10.53709/ CHE.2021.v02i04.017