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Impact on soil salinity and crop yield under conventional and controlled subsurface drainage system in saline Vertisols of TBP irrigation command

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Abstract

Performance of conventional sub-surface drainage system (SSD) on the reclamation of waterlogged and saline soils mainly depends on proper drainage discharge to the nala through the outlets. Farmers at the tail-end of the TBP irrigation command who often face scarcity of water especially at the later part of crop growth are in practice of clogging the outlets so as to retain water in the field for the crop. This practice has lead to the inefficient SSD network in the command. Hence, controlled drainage system was planned with slight modification to the existing traditional SSD in three spacing such as 40 (2.62 ha), 50 (2.8 ha) and 60m (4.0 ha) at Agricultural Research Station, Gangavathi during 2021-22 to assess the performance of different spacing of conventional sub surface drainage system in comparison with controlled drainage on salinity and crop yield in saline rice fields. The mean soil salinity (EC_e) in all the spacing under both conventional and controlled drainage system was reduced. The paddy grain yield varied from 33.0 to 48.3 vs. 38.0 to 54.2, 36.0 to 56.3 vs. 31.0 to 43.7 and 37.6 to 47.2 vs. 36.0 to 51.3 qha⁻¹ under conventional and controlled SSD at 40, 50 and 60 m spacing respectively.

Keywords: Subsurface drainage, controlled drainage, soil salinity, crop yield

Introduction

Tungabhadra Project (TBP) reservoir on Tungabhadra river, a tributary of river Krishna, was commissioned in 1953 (Anonymous, 2013) to provide protective irrigation to the drought prone areas of Northern Karnataka (3,63,000 ha) and Andhra Pradesh (1,60,000 ha). Based on soil characteristics, topographical and drainage conditions of the command area, it was proposed to allocate nearly 8 and 4 per cent of command area under paddy and sugarcane, respectively, to avoid development of waterlogged and soil salinity (Karegoudar *et al.*, 2022) ^[4]. Presently deviation in the cropping pattern, farmers in downstream areas is not only facing shortage of canal water supply for paddy crop but also the problem of secondary salinization and thus reduction in the yield levels of different crops drastically. To reclaim these lands TBP-CADA (Tungabhadra Project- Command Area Development Authority) has taken up surface and sub-surface drainage (SSD) works especially in the downstream area of the command. However, there are issues related to operation of SSD systems. The farmers in downstream area stop/block the SSD system due to fear of water shortage during critical stages of paddy crop coupled with leaching loss of nitrate nitrogen (N). However, earlier results by the blockage of outlets increased soil salinity from 2.22 to 4.1 dSm⁻¹ during *rabi* and from 2.22 to 2.68 dSm⁻¹ during *Kharif* within two years after adoption of blockage practice. It means that blockage of the system undo benefits of SSD system. This experience suggested that SSD system should work but in controlled way. This controlled system is known to reduce the drainage discharge while maintaining the necessary function of the drainage system. Ghannam *et al.*, (2016) ^[2] reported that controlled drainage significantly reduced drainage volumes and salt loads compared to unmanaged systems. However, there were marked increases in soil salinity due to rising of water table but carefully monitored and managed the system. In view of the above, a study the effect of controlled drainage on soil salinity and crop yield in different spacing under saline vertisols of TBP Command area was planned.

Materials and Methods

The study was carried out in a 9.42 ha area at Agricultural Research Station, Gangavathi during the year of 2021-22. The treatments consisted of conventional and controlled SSD spacing viz., 40 (2.62 ha), 50 (2.8 ha) and 60 m (4.0 ha) each with a lateral depth of 1.0 m. These three experimental lands were divided into two equal plots to establish conventional and controlled sub surface drainage systems and each was served by three lateral drains. In both the systems, the collector drains (100 mm diameter PVC corrugated plastic pipe) were installed perpendicular to surface drain (*nala*) at 1.10 m depth and all lateral drains (PVC corrugated pipe covered by synthetic envelope materials) were installed at a depth of 1.0 m with an average spacing of about 50 m between the laterals. The slope of lateral drain was 0.1 to 0.2% and connected to the collector drains whose slope was 0.2 to 0.3% which directly drains into

nala through man hole.

In controlled drainage system the water table control device was made up of PVC pipe consisting of three parts (Fig.1). The first is a horizontal PVC pipe 80 mm diameter fitted onto the end of lateral drain inside the man hole and closed at the end by a PVC closing device (Karegoudar *et al.*, 2019) [3]. The second part is a riser with the provision of variable height depending on the minimum water table depth required and connected with the first part. In this study controlled drainage was applied at 30 cm water table depth from the soil surface at the outlet of lateral drain during both *kharif* and *rabi* seasons of paddy. The third part is another horizontal PVC pipe (80 mm dia) connected with the riser as a lateral drain at the desired minimum water table depth. This control device was designed in such a way to restrict the drain flow by blocking the actual drain outlet as is the case in conventional SSD system.

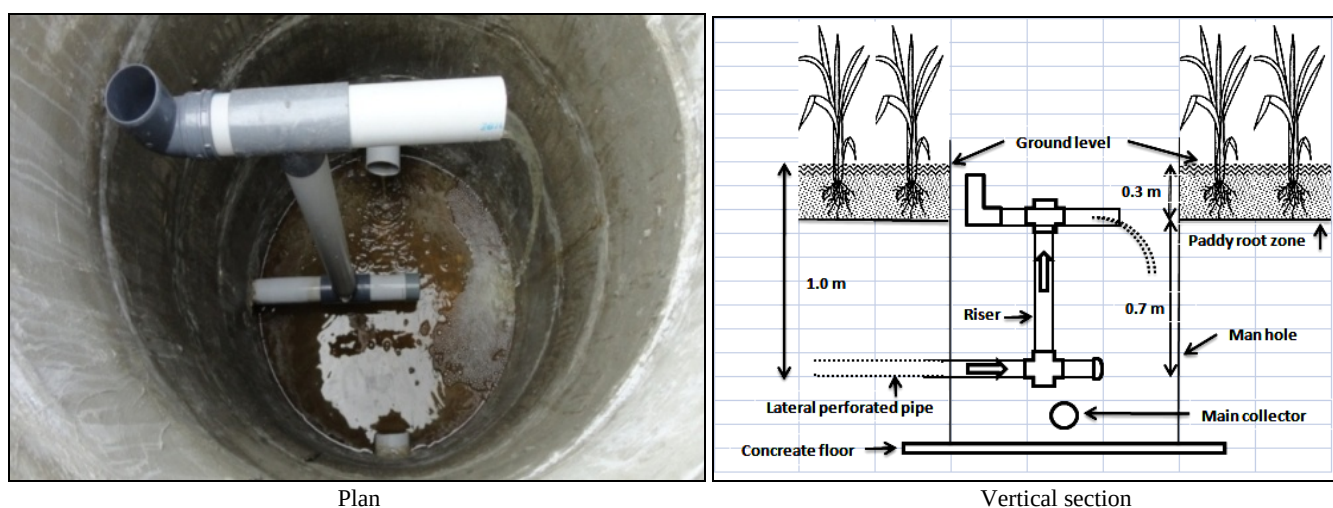


Fig 1: A view of indigenously developed water table control device installed in manhole (Adopted from: M.A.S. Wahba *et.al*, 2001) [6]

Rice was transplanted in *Kharif* -21 (BPT 5204) season in these experimental sites. The paddy crop was transplanted in August and January and harvested in December season. Except the control device, agronomic practices followed for paddy were similar in both the systems. The soil samples were collected to a depth of 90 cm with 15 cm increment were taken from both conventional and controlled plots in zigzag position using GPS and analyzed for initial soil pH and soil salinity (EC, dSm^{-1}) on a 1:2.5 soil water suspension and the EC so obtained was converted to ECe (dSm^{-1}) i.e., EC of saturation paste extract by multiplying EC with a conversion factor 2.66 which was worked out for these soils at ARS, Gangavathi (USSS, 1954). Soil samples to a depth of 90 cm were also collected at the end of each cropping season and analyzed for soil salinity appraisal.

Results and Discussion

Soil salinity: The mean soil salinity under 40 m spacing under conventional SSD during *Kharif*-21 reduced from 8.05 to 2.44 at 0-15cm, from 8.66 to 3.35 at 15-30 cm, from 9.70 to 4.17 at 30-60 cm and from 9.94 to 4.30 dSm^{-1} at 60-90 cm, respectively (Table.1). In case of controlled drainage system, the average soil salinity reduced from 7.34 to 1.20 dSm^{-1} at 0-15 cm, from 8.15 to 3.15 dSm^{-1} at 15-30 cm and salinity increased from 8.63 to

4.34 dSm^{-1} at 30-60 cm and from 9.18 to 3.90 dSm^{-1} at 60-90 cm, respectively.

The mean soil salinity under 50 m spacing under conventional SSD during *Kharif*-21 reduced from 4.30 to 1.34 at 0-15cm, from 5.09 to 1.22 at 15-30 cm, from 5.91 to 1.73 at 30-60 cm and from 5.26 to 2.71 dSm^{-1} at 60-90 cm, respectively. In case of controlled drainage system, the average soil salinity reduced from 6.30 to 1.50 dSm^{-1} at 0-15 cm, from 8.29 to 3.44 dSm^{-1} at 15-30 cm, from 12.0 to 3.75 dSm^{-1} at 30-60 cm and from 13.85 to 4.57 dSm^{-1} at 60-90 cm, respectively.

The mean soil salinity under 60 m spacing under conventional SSD during *Kharif*-21 reduced from 3.06 to 1.87 at 0-15cm, from 3.83 to 2.66 at 15-30 cm, from 7.21 to 4.52 at 30-60 cm and from 8.79 to 4.50 dSm^{-1} at 60-90 cm, respectively. In case of controlled drainage system, the average soil salinity reduced from 5.99 to 2.24 dSm^{-1} at 0-15 cm, from 6.29 to 3.26 dSm^{-1} at 15-30 cm, from 6.42 to 3.33 dSm^{-1} at 30-60 cm and from 6.11 to 5.20 dSm^{-1} at 60-90 cm, respectively. Results of the study indicated that, irrespective of the spacing, with continuous flow of drain water removal of dissolved salts through drainage effluent was faster as well as from deeper depth in conventional drainage than controlled drainage system (Karegoudar *et al.*, 2019) [3].

Table 1: Changes in soil salinity (EC_e , dSm^{-1}) over cropping season under different spacing of conventional and controlled SSD

Season	40 m spacing							
	Conventional drainage (cm)				Controlled drainage (cm)			
	0-15	15-30	30-60	60-90	0-15	15-30	30-60	60-90
Initial	8.05	8.66	9.70	9.94	7.34	8.15	8.63	9.18
<i>Kharif-21</i>	2.44	3.35	4.17	4.30	1.20	3.15	4.34	3.90
Season	50 m spacing							
	Conventional drainage (cm)				Controlled drainage (cm)			
	0-15	15-30	30-60	60-90	0-15	15-30	30-60	60-90
Initial	4.30	5.09	5.91	5.26	6.30	8.29	12.00	13.85
<i>Kharif-21</i>	1.34	1.22	1.73	2.71	1.50	3.44	3.75	4.57
Season	60 m spacing							
	Conventional drainage (cm)				Controlled drainage (cm)			
	0-15	15-30	30-60	60-90	0-15	15-30	30-60	60-90
Initial	3.06	3.83	7.21	8.79	5.99	6.29	6.42	6.11
<i>Kharif-21</i>	1.87	2.66	4.52	4.50	2.24	3.26	3.33	5.20

Grain yield: During *Kharif-21* paddy grain yields were 48.3 vs. 43.7, 54.2 vs. 47.2 and 56.3 vs. 51.3 qha^{-1} under conventional and controlled drainage systems at 40, 50 and 60 m SSD spacing respectively (Table.2).

Table 2: Variation of paddy grain yield (qha^{-1}) as influenced by spacing of SSD and controlled drainage systems

Season	Conventional sub surface drainage			Controlled sub surface drainage		
	40 m	50 m	60 m	40 m	50 m	60 m
Initial	33.0	38.0	36.0	31.0	37.6	36.0
<i>Kharif-21</i>	48.3	54.2	56.3	43.7	47.2	51.3
Improved over initial (%)	31	30	36	29	20	30

Conclusion

The rate of reclamation of waterlogged saline land was faster under conventional drainage as compared to controlled drainage. The continuous flow of drain water removal of dissolved salts through drainage effluent was faster as well as from deeper depth in conventional drainage than controlled drainage system. Hence, mean soil salinity (EC_e) in all the spacing under both conventional and controlled drainage system was reduced. The paddy grain yield improvement was slightly higher (from 30 to 36%) for conventional as compared to controlled drainage conditions (from 20 to 30%) at 40 to 60 m spacing respectively.

References

1. Anonymous. Annual report. Command Area Development Authority (CADA), Tungabhadra Project. Munirabad, Karnataka, India; 2013. p. 1-30.
2. Ghannam EMK, Waly ME, Gaheen SA, Karajeh FF, Gendy AA. Controlled drainage effects on nitrate leaching, salinity buildup and sugar beet production in Egypt. Merit Research Journal of Agricultural Science and Soil Sciences. 2016;4(2):23-32.
3. Karegoudar AV, Vishwanath J, Anand SR, Rajkumar RH, Ambast SK, Kaledhonkar MJ. Feasibility of controlled drainage in saline vertisols of Tungabhadra Project command area of Karnataka, India. Irrigation and Drainage. 2019;68:969-978.
4. Karegoudar AV, Viswanath J, Rajkumar RH, Anand SR, Poligowdar BS, Ayyanagowdar MS, Nemichandappa M, Kaledhonkar MJ. Economic feasibility of subsurface drainage to control waterlogging and soil salinity under different scenarios in Tungabhadra Project command, Karnataka. International Journal of Irrigation and Drainage. 2022;71:1063-1076.
5. United States Salinity Laboratory. Diagnosis and improvement of saline and alkali soils. In: Richards LA, editor. USDA handbook. Washington (DC): United States Department of Agriculture; 1954. p. 1-60.
6. Wahba MAS, El-Ganainy M, Abdel-Dayem MS, Gobran A, Kandil. Controlled drainage effects on water quality under semi-arid conditions in the western delta of Egypt. Journal of Irrigation and Drainage. 2001;50:295-308.