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Performance of Gatton Panic (*Panicum maximum* Jacq) and Ameliorative Changes in Coastal Salt Affected Soils Under Varying Land Configurations

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Abstract: The performance of Gatton panic (*Panicum maximum* Jacq) and ameliorative changes was studied in coastal salt affected soils under varying land configurations. The results indicated that green forage yield was increased 93.45 and 141.91% under broad bed furrow system of land configuration Vs traditional method of flat bed planting during 1992-93 and 1993-94, respectively. Soil properties like pH, EC (Electrical conductivity), ESP (Exchangeable Sodium Percentage) and bulk density were improved significantly in land configuration treatments as compared to control, whereas fertility status of the soil in respect to organic matter, total nitrogen, available phosphorus and potassium were significantly increased. Further, it can be revealed that growing of Gatton panic (*Panicum maximum* Jacq) with broad bed and furrow system of land configuration was best in respect to pronounced effects on green forage yield as well as drastic improvement in soil properties were registered under the narrowest (S_3= 2.4 x 6.0 m) bed and deepest furrow (D_3 = 60 cm) depth in coastal salt-affected soils.

Key words: Gatton Panic, ameliorative effect, land configuration, coastal salt-affected soils

INTRODUCTION

Nearly 23.7 million ha of salt-affected soils are lying as such barren and unproductive due to salinity-sodicity problem in India[1]. Out of which, Gujarat with 1600 km long coastal belt accounts for 0.914 million ha. However, the increasing population pressure at an alarming rate reached up to more than one billion in India, create a vital issue and challenge to the agriculture scientist for increasing demand of food, fodder and fibre. Therefore, to bring this vast unproductive area under cultivation, land configuration technology like broad bed and furrow, raised bed and furrow, raised bed and sunken bed are as effective as drainage system in removing the excess soil water and soluble salts from the rhizosphere through the creaks formed as a result of deeper root proliferation, which hastens the process of biological rejuvenation in salt-affected soils. These findings are also in accordance with those reported by Nalwade and More[2], Devedattam[3] and Selvaraju and Ramaswami [4],keeping above facts in view, the present investigation was under taken.

MATERIALS AND METHODS

A field experiment with Gatton panic grass was conducted at Agricultural Research Station, Danti, Gujarat Agricultural University, Navsari Campus, Navsari consecutively for two years (1992-93 and 1993-94). This experiment was conducted on fixed layout in split plot design with treatments comprising each of 3 furrow depths (D_1=30, D_2=45 and D_3=60 cm) allotted to main plot and 3 bed widths (S_1=4.8, S_2=3.6, S_3=2.4 m) placed in sub plot along with one control (Flat bed planting) outside the experiment, were tasted. The experimental soil was clayey (60.03% clay), alkali in reaction (pH=9.4 and ESP=33.17), saline ($EC_{2.5}$=4.37 dS m^{-1}), low in organic carbon (0.25%) as well as available P (20 kg P_2O_5 ha^{-1}) and high in available K (325 kg K_2O ha^{-1}). Two slips of Gatton panic grass were planted per hill at a spacing of 15x30 cm. The crop was fertilized with 60 kg nitrogen and 30 kg P_2O_5 ha^{-1}, respectively. Out of which 50% of the nitrogen and entire quantity of phosphorus applied in form of ammonium sulphate and Diammonium phosphate, respectively at the time of transplanting as a basal dose, where as remaining 50% of the nitrogen was top dressed one month after transplanting. For ratoon crop only N was applied @ 60 kg ha^{-1} in two equal splits. The crop was irrigated 4 times in first year only for initial uniform establishment. Subsequently, no irrigation was given during the period of experimentation. Every year two cuttings were done. The chemical analysis was carried out using standard methods to ascertain the pH, EC, ESP, uptake of N, P, K and Na, organic matter, total nitrogen,

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available phosphorus and potassium before and after each cuts to monitor the periodical changes in soil properties. As regards to the statistical analysis, the treated sets of land configuration treatments were also compared Vs flat bed planting (control) by using student's "t" test.

RESULTS AND DISCUSSION

Effect of land configuration vs control: The land configuration treatment significantly increased the green forage yield as well as drastic improvement in soil properties viz; soil pH, EC, ESP, bulk density and appreciable increase in organic matter, total nitrogen, available phosphorus and potassium were observed, respectively over traditional method of flat bed planting. The mean increase in green forage yield under land configuration system Vs control significantly produced higher yield and found almost double in each successive cuts (Table 1). The similar trend was observed in case of soil properties. These findings were in accordance with those reported by Belayneth[5] and Sadik *et al.*[6].

Effect of furrow depth: The successive increase in furrow depth (from 30 to 45 cm and 45 to 60 cm) progressively and significantly increased the green forage yield as well as improved the soil properties like soil pH, EC, ESP, uptake of N, P, K and Na, respectively.

There were significant and drastic reduction or improvement in pH, EC, ESP and bulk density from 9.43, 4.37 dS m^{-1}, 33.17 and 1.68/M gm^{-3} over (Initial value) to 7.63, 2.07, dS m^{-1}, 17.49 and 1.50 M gm^{-3}, respectively was observed under the deepest furrow (D_3=60 cm) depth after the harvest of fourth cut (Table 2).

The significant improvement in fertility status of the soil i.e. organic matter, total nitrogen, available phosphorus and potassium from 0.35, 0.02, 19.70 kg P_2O_5 ha^{-1} and 325.30 kg K_2O ha^{-1} over (Initial value) to 1.19, 0.06, 41.78 kg P_2O_5 ha^{-1} and 412.41 kg K_2O ha^{-1} respectively was recorded under the deepest furrow (D_3=60 cm) depth after the harvest of fourth cut (Table 3). These findings are in agreement with those reported by Nalwade and More[2], Sadik *et al.*[6] and Devadattam[5].

The significant improvement in crop yield and soil properties under deeper furrow depth might be due to better root proliferation, the cracks formed as a result of deeper root penetration, which ultimately results in rapid removal of soluble salts up to greater depth (D_3=60 cm). Moreover, addition of root biomass and crop residues improved the soil aggregation. The displacement of Na^+ by Ca^{++} ions on exchangeable complex due to increased solubilization of $CaCO_3$ by the carbonic acid produced as a result of the microbial decomposition/humification on organic matter and addition of grass litter, higher root proliferation exhaled by roots also forms carbonic acid in the rhizosphere. Almost similar reasons were also reported by Nalwade and More[2].

Table 1: Effect on green forage yield of gatton panic by varying land configuration in coastal salt affected soils

	Green forage yield (q ha^{-1})			
	1992-93		1993-94	
Treatments	1st cut	2nd cut	3rd cut	4th cut
Furrow depths (cm)				
D_1-30	68.37	80.37	98.35	99.79
D_2-45	83.00	95.67	115.01	115.49
D_3-60	100.65	114.41	134.41	135.44
S.Em±	3.10	3.36	2.65	2.69
C.D. at 5% level	10.75	11.63	9.27	9.33
Bed widths (m)				
S_1-4.0x6.0	76.30	89.23	108.82	109.49
S_2-3.6x6.0	83.10	96.01	115.29	115.95
S_3-2.4x6.0	92.54	105.21	123.66	125.28
S.Em±	2.05	2.62	1.41	1.45
C.D. at 5% level	6.09	6.02	4.23	4.32
Mean of treatments	84.00	96.01	115.92	116.90
Control	46.25	47.22	47.95	48.29
Control V/s Rest				
(" t " test)	**	**	**	**
Interaction (DxS)				
S.Em±	3.55	3.51	2.49	2.51
C.D. at 5% level	NS	NS	NS	NS

Table 2: Effect of land configuration treatments on PH, EC, ESP and bulk density in coastal salt-affected soils

	Soil properties			
Treatments	pH (1:2.5)	EC (1:2.5)	ESP	Bulk-density (Mgm^{-3})
Initial value	9.43	4.37	33.17	1.68
Furrow depths (cm)				
D_1-30	8.10	2.31	20.03	1.55
D_2-45	7.92	2.20	17.98	1.53
D_3-60	7.63	2.07	17.49	1.50
S.Em±	0.02	0.02	0.39	0.00
C.D. at 5% level	0.08	0.08	1.36	0.03
Bed widths (m)				
S_1-4.0 x 6.0	8.12	2.49	22.74	1.56
S_2-3.6 x 6.0	8.00	2.25	19.12	1.52
S_3-2.4 x 6.0	7.53	1.84	13.64	1.50
S. Em±	0.03	0.03	0.35	0.00
C.D. at 5% level	0.10	0.10	1.05	0.01
Mean of treatments	7.88	2.19	18.50	1.52
Control	9.13	3.00	27.65	1.63
Control V/s Rest				
(" t " test)	**	**	**	**
Interaction (DxS)				
S.Em±	0.06	0.05	0.61	0.00
C.D. at 5% level	NS	NS	NS	NS

**Significant at 1% level

Effect of bed width: The green forage yield and soil properties were significantly influenced by the different sizes of bed. The maximum green forage yield and drastic

Table 3: Effect of land configuration treatments on organic matter, total nitrogen, available phosphorus and potassium in coastal salt-affected soils

Treatments	Organic matter (%)	Total nitrogen (%)	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})
Initial value	0.25	0.02	19.70	325.30
Furrow depths (cm)				
D_1-30	1.00	0.05	36.83	376.83
D_2-45	1.11	0.05	38.44	390.83
D_3-60	1.19	0.06	41.78	412.41
S.Em±	0.02	0.00	0.76	3.04
C.D. at 5% level	0.06	0.00	2.63	10.52
Bed widths (m)				
S_1-4.8 x 6.0	0.60	0.08	36.86	374.83
S_2-3.6 x 6.0	0.69	0.06	39.20	393.41
S_3-2.4 x 6.0	0.80	0.06	40.99	411.83
S.Em±	0.01	0.00	0.59	2.17
C.D. at 5% level	0.03	0.00	1.76	6.47
Mean of treatments	0.69	0.05	39.01	393.35
Control	0.28	0.03	28.36	345.00
Control V/s Rest (" t " test)	**	**	**	**
Interaction (DxS)				
S.Em±	0.02	0.002	1.02	3.77
C.D. at 5% level	NS	NS	NS	NS

** Significant at 1% level

reduction/improvement in the soil properties were obtained under the narrowest bed size S_3 (2.4x6.0 m). The magnitude of increase from S_1 to S_2 was 9.00, 6.92, 4.65 and 5.91% while that from S_2 to S_3 was 11.35, 9.58, 7.25 and 8.02% in I, II, III and IV cut, respectively (Table 1).

There were drastic reduction in soil pH, EC, ESP and bulk density from 9.43, 4.37 dS m^{-1}, 33.17 and 1.600 M gm^{-3} over (Initial value) to 7.54, 1.84, dS m^{-1}; 13.64 and 1.50 M gm^{-3}, respectively observed under the narrowest bed size S_3 (2.4 x 6.00 m) after the final harvest of fourth cut.

The appreciable increase in organic matter, total nitrogen, available phosphorus and potassium from 6.25, 0.02, 1970 kg P_2O_5 ha^{-1} and 325.30 kg K_2O ha^{-1} over (Initial value) to 1.19, 0.06, 41.78 kg P_2O_5 ha^{-1} and 412.41 kg K_2O ha^{-1}, respectively registered under the narrowest bed size (S_3 = 2.4x6.0 m). Similar results were corroborate the findings of Belayneth[5] and Sadik *et al.*[6].

The superiority of the narrowest bed in respect to green forage yield, improvement of soil properties and pronounced effect on improvement in soil fertility values were ascribed to: rapid removal of excess rain water and soluble salts from the rhizosphere in narrowest bed size (S_3 = 2.4x6.0 m) resulted in decrease in soil pH, EC, ESP, bulk density and subsequently improved the fertility status of the soil and therefore, plant can produce higher green forage yield under land configuration system over traditional method of flat bed planting. Similar reasons are supported by Belayneth[5], Nalwade and More[2].

On the basis of two years results, it can be concluded that green forage yield was increased 93.45 and 141.91% under broad bed furrow system of land configuration Vs traditional method of flat bed planting during 1992-93 and 1993-94, respectively. Soil properties like pH, EC (Electrical conductivity), ESP (Exchangeable Sodium Percentage) and bulk density were improved significantly in land configuration treatments as compared to control, whereas fertility status of the soil in respect to organic matter, total nitrogen, available phosphorus and potassium were significantly increased. Further, it can be revealed that growing of Gatton panic (*Panicum maximum* Jacq) with broad bed and furrow system of land configuration was found best in respect to pronounced effects on green forage yield as well as drastic improvement in soil properties were registered under the narrowest (S_3= 2.4x6.0 m) bed and deepest furrow (D_3 = 60 cm) depth in coastal salt-affected soils.

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