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Production of Triticale Genotypes in Two Salt Affected Areas of Bangladesh for Grain and Fodder

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Abstract
Fifteen genotypes of Triticale were tested in two salt affected locations namely Satkhira and Noakhali during 2006-07. At Satkhira, genotype E_6 and E_{14} produced significantly the highest grain yield (2.00 t/ha) from December 28 sowing date. While the highest fodder yield was obtained from line E_7 (6.94 t/ha). However, E_6 produced good amount of green fodder (5.62 t/ha) as well as the highest grain yield (2.00 t/ha), so, genotype E_6 could be used for dual purposes. On the other hand, at Noakhali genotype E_5 gave the highest grain yield (2.48 t/ha) which was statistically similar to E_{11}. However, E_{11} produced the highest amount of green fodder (9.88 t/ha). Hence, E_{11} could be used for the dual purposes. In both locations it was observed that soil salinity above 6-7 dS/m hampered the growth and development of the crop. To reduce the toxic effects of salinity on seeds, irrigation would be advisable just after sowing. Crop failure was observed when soil salinity was above 10 dS/m.

Keywords: Triticale genotypes, salinity, grain, fodder.

1. Introduction

One-third of the world's irrigated lands and half of the lands of semi-arid and coastal regions are estimated to be affected by different degrees of salinity. About 7 percent of total land area and 30 percent of the potentially arable lands in world has been affected by salinity (Abrol *et al.*, 1985). In Bangladesh, total saline area is about 0.88 million hectares of which 0.38 million hectares are in Khulna, 0.22 million hectares in Patuakhali, 0.11 million hectares in Chittagong and 0.17 million hectares in Barisal and Noakhali regions (MPO, 1986). Fodder and feed scarcity is one of the major bottlenecks for livestock sector development (BLRI, 2007). Hardly any land is available for fodder production only due to acute land crisis. But dual purpose crops such as Triticale (*X. triticosecale* Wittmack) could become an alternative option. Triticale is a man-made cross between rye and durum wheat and that has the ability to produce quality green fodder and considerable quantity of grain through re-growth after cutting green fodder. It could be grown in existing rice-based cropping systems in Bangladesh and has the ability to produce 10-12 t fresh weight of biomass/ha from two cuts in a season. Its fodder is rich in lysine and tryptophane, the essential amino acids for the growth and development of livestock. Triticale straw contains almost double amount of crude protein (CP) than traditional rice straw (BLRI, 2007). Moreover, it is reported that triticale is comparatively more salt tolerant than traditional wheat and field pea (Clapham *et al.*, 2008; Kotuby-Amacher *et al.*, 1997; Bishnol and Pancholy, 1980). It is the crop's sensitivity or tolerance to salinity which essentially defines the salinity of the soil; a soil may be too saline

for one crop but it may be quite suitable and productive for another crop (Anon, 2006b). Therefore, for management of salt affected soils, crop selection is also an important decision. Coastal soils vary widely in nature of salinity, depth and fluctuation of groundwater along with the seasonal variation in the salinity of surface water. The maximum salinity occurs in the months of March and April while the minimum in the months of July and August after the onset of the monsoon rains (Mondal, 2001). However, as normal fertile land is used for the cultivation of different rabi crops and boro rice, adaptability and potentiality of triticale should be tested in fallow lands in the coastal and moderately salt affected areas. Before adaptation, performance of some genotypes needs to be evaluated in saline areas. Considering the above situations, trial cultivation of Triticale was undertaken in two major saline belts of Bangladesh viz. Satkhira and Noakhali.

2. Materials and Methods

The trial was conducted at Banerpota Farm of Bangadesh Agricultural Research Institute (BARI), Satkhira and Farming Systems Research and Development (FSRD) site of BARI, Hajirhat, Noakhali during the Rabi season of 2006-2007 with fifteen triticale genotypes namely E_1, E_2, E_3, E_4, E_5, E_6, E_7, E_8, E_9, E_{10}, E_{11}, E_{12}, E_{13}, E_{14}, and E_{15} following RCB design with two replications. The unit plot size was 5m×1m. At Satkhira the crop was sown on 28 December 2006, while at Noakhali sowing was done on 4 December, 2006 as line sowing. Line to line distance was 20cm. Fertilizers were applied at the rate of 126-26-38-20 kg NPKS ha^{-1} as urea, TSP, MP and gypsum, respectively. All the amount of TSP, MP and Gypsum were applied as basal while 55 % of urea was applied as basal and the rest 45 % as top dress after cutting of green fodder at 45 days after sowing (DAS). Three irrigations were given during the crop growing period. Cutting of green fodder was done on 45th DAS at Satkhira and on 42nd DAS at Noakhali. The land was kept weed free. Data on grain yield, yield attributes and green fodder yield were collected and analyzed statistically by using MSTAT program. The soil salinity levels of both the experimental sites were recorded (Figs. 1 and 2) by using Electrical Conductivity meter (Model No. Hanna HI-933100). Total rainfall as well as the maximum and the minimum temperature (^{0}C) of both the experimental sites during the crop growing period were recorded (Appendix 1 and 2).

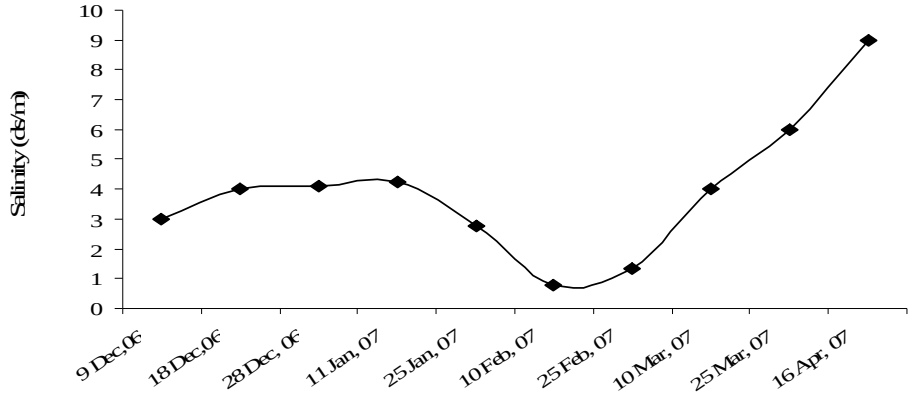

Fig.1. Soil salinity level over time, Banerpota, Satkhira, 2006-07.

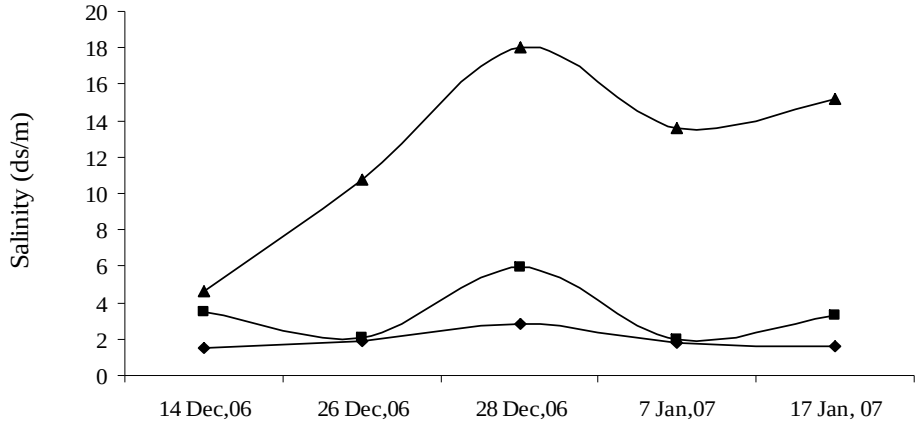

Fig.2. Soil salinity level in different replications of triticale field in Noakhali, 2006-07 (Rep 3 plant mostly died due to high salinity).

Table 1. Grain and fodder yields of triticale genotypes at Banerpota Farm, Satkhira during rabi season of 2006-2007

Entry	Days to maturity	Plant height (cm)	Spike/m^2 (No.)	Grain/spike (No.)	1000 grain weight (g)	Fodder * yield (t/ha)	Grain yield (t/ha)
E_1	94	66.50	260.0	29.50	31.01	3.46	1.12
E_2	99	62.50	308.5	27.50	31.12	4.50	1.37
E_3	100	69.50	271.5	26.50	28.30	4.75	1.12
E_4	100	74.00	286.5	24.00	31.21	4.70	0.97
E_5	99	73.00	243.5	25.50	27.44	5.80	0.74
E_6	99	67.00	341.0	30.50	30.29	5.62	2.00
E_7	93	62.00	245.5	21.50	38.27	6.94	0.87
E_8	94	68.50	252.5	24.50	29.77	6.37	0.87
E_9	98	69.50	261.0	31.50	32.52	5.05	1.24
E_{10}	93	64.50	329.0	26.50	31.85	5.00	1.09
E_{11}	95	70.00	336.0	25.50	30.96	2.87	1.49
E_{12}	100	80.00	278.5	28.00	31.75	4.55	0.87
E_{13}	100	66.00	272.0	22.50	31.31	3.37	1.12
E_{14}	101	73.00	373.0	28.00	30.91	4.45	2.00
E_{15}	101	68.50	262.5	27.00	30.62	2.82	0.87
LSD (0.05)	--	11.37	94.28	3.13	7.65	0.45	0.29
CV (%)	--	7.74	15.36	15.28	11.53	4.54	11.74

***** Fodder yield data was recorded at 45 DAS

Table 2. Grain and fodder yields of triticale genotypes at FSRD site, Hajirhat, Noakhali during rabi season of 2006-2007

Entry	Days to maturity	Plant height (cm.)	Spike/m^2 (No.)	Grains/spike (No.)	1000 grain weight (g)	Fodder* yield (t/ha)	Grain yield (t/ha)
E_1	108	106.91	120.0	39.5	35.5	4.89	1.21
E_2	113	87.41	139.5	32.3	31.10	7.04	1.21
E_3	114	93.02	162.0	38.6	34.05	6.72	1.55
E_4	114	92.33	171.0	31.2	35.00	6.48	1.59
E_5	113	96.13	218.5	46.3	33.10	7.87	2.48
E_6	112	80.45	202.0	35.2	35.95	8.32	1.91
E_7	112	70.50	161.5	35.9	30.10	6.79	1.41
E_8	113	81.22	141.0	36.1	30.50	7.95	1.21
E_9	114	95.84	137.5	30.8	31.00	6.94	1.35
E_{10}	113	94.15	131.5	32.4	33.50	7.92	1.28
E_{11}	114	86.05	225.5	39.0	35.00	9.88	2.34
E_{12}	114	85.14	155.5	28.8	41.50	7.63	1.51
E_{13}	112	80.61	161.0	33.3	32.50	6.95	1.29
E_{14}	113	96.98	156.0	39.4	34.50	8.01	1.50
E_{15}	112	81.36	175.0	31.5	29.50	9.23	1.27
LSD (0.05)	--	9.61	27.55	6.9	5.68	2.35	0.14
CV (%)	--	2.3	10.4	7.3	2.9	4.2	10.7

*Fodder yield data was recorded at 42 DAS

3. Results and Discussion

Plant height, spike/m^2, 1000 grain weight, green grass yield, grain yield and straw yield of triticale were found to vary significantly among the genotypes at Satkhira (Table 1). The highest grain yield (2.00 t/ha) was obtained both from E_{14} and E_6, this could be due to the maximum spike/m^2 and heavier seed weight. E_5 produced the lowest grain yield (0.74 t/ha). The highest green fodder yield (6.94t/ha) was obtained from E_7. At Noakhali the entire yield and its attributes varied among the genotypes (Table 2). E_5 gave the highest grain yield (2.48 t/ha) which was identical with E_{11} (2.34 t/ha) because of combined effect of higher number of grains/spike and spikes/m^2. For the purpose of green fodder production E_{11} was the best (9.88 t/ha) which was at par with E_{15} (9.23 t/ha). For dual purpose (fodder and grain production), E_{11}

seems to be better. In both the salt affected locations grain yields were 25-30 % lower than that obtained from non-saline areas due to lower number of grains/spike and reduced 1000-seed weight. Islam *et al.,* (2004) observed that increasing salinity decreased almost all growth parameters gradually, which indicates that final yield will decrease due to salinity stress. Salinity stress tended to shorten the duration of spikelet differentiation, resulting in fewer spikelets per spike. The present findings agree with those of Anon. (2006a) and Akram *et al.* 2002). Many other authors also reported that salinity significantly decreased the number of spikelet primordia on the main spike (Grieve *et al.,* 1993; Francois *et al.,* 1994; Mass and Grieve, 1990). However, Francois *et al.* (1988) reported that yield reduction resulted primarily from a reduction in spike number rather than from lower weight per spike or lower weight per individual seed up to 7.3 dS/m. Triticale also performed moderately up to 6-7 dS/m across locations.

4. Conclusions

Triticale could be an alternative option for brining fallow saline areas under cropping during rabi season. It was observed that triticale is a bit more salt tolerant in comparison to other competitive crops. At Satkhira, E_{14} and E_6 triticale genotypes performed better, moreover, E_6 could be used for both green fodder and grain production. Whereas at Noakhali, E_5 and E_{11} gave higher grain yield. E_{11} also produced the highest green fodder yield; hence this genotype could be used for dual purpose. Therefore, triticale could be grown in Fallow-T. Aman -Fallow cropping pattern in the vast fallow land of the saline belt during the rabi season.

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Appendix 1. Monthly rainfall (mm) and temperature (^{0}C) of the experimental site (Noakhali) during the crop growing period

Month	Rainfall (mm)	Temperature (^{o}C)			
		2006		2007	
		Maximum	Minimum	Maximum	Minimum
November, 2006	20	29.15	20.11	29.3	21.28
December, 2006	0	26.11	15.70	25.2	16.17
January, 2007	0	25.76	14.45	24.42	13.11
February, 2007	74	31.1	19.43	27.3	16.8
March, 2007	9	32.67	21.42	30.4	18.6
April,2007	139	34.38	24.13	33.49	23.3
Total	242				

Source: Department of Meteorology, Dhaka, Bangladesh

Appendix 2. Monthly rainfall (mm) and temperature (^{0}C) of the experimental site (Khulna) during the crop growing period

Month	Rainfall (mm)	Temperature (^{o}C)			
		2006		2007	
		Maximum	Minimum	Maximum	Minimum
November, 2006	1	29.6	19.44	29.7	21.0
December, 2006	0	26.9	15.03	27.3	15.0
January, 2007	0	25.9	12.81	24.9	12.3
February, 2007	54	31.8	18.81	27.6	16.9
March, 2007	14	33.3	21.09	30.2	19.9
April, 2007	92	35.0	24.93	34.1	25.5
Total	161				

Source: Department of Meteorology, Dhaka, Bangladesh