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Hormonal Enhancement of Rooting in Sugarcane Settlings

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ABSTRACT

Rooting responses in stalkless settlings of three sugarcane varieties were studied using different concentrations (0.2, 0.5, 1.0, 2.0 and 5.0mg l^{-1}) of NAA, IBA and IAA. Stalkless settlings were soaked for 12, 24 and 36 h and transplanted in the main field at two soil moisture regimes. Survival of settlings and rooting were recorded. Significantly higher survival of settlings and rooting were found at optimum soil moisture regime when settlings were soaked at 2mg l^{-1} NAA followed by 2mg l^{-1} IBA. At soil moisture stress, significantly higher survival and rooting were observed when settlings were soaked at 5mg l^{-1} NAA compared to other treatments. No significant varietal responses to the hormone treatments was observed in respect to rooting and settling survival. Results indicated promise of transplanting sugarcane settlings with higher survival and adequate rooting upon transplantation. The significance of hormone treated seed usage for higher settlings establishment and seed economy have been highlighted.

Key words: Sugarcane, settlings, roots, hormone, soil moisture, polybag, soilbed

INTRODUCTION

Sugarcane is one the most important cash-cum-industrial crop in Bangladesh. It is a principal cash crop especially in north-western and south-western low rainfall belt of Bangladesh. Sugarcane is the main raw material for sugar and gur industries. In Bangladesh, three budded setts are directly planted in the trenches usually during the months of November to following February when ambient temperature remains bellow 20°C. It has been reported earlier from this laboratory that sugarcane bud germination is severely affected if ambient temperature goes bellow 20°C (Miah *et al.*, 1988; Hossain *et al.*, 1989). To solve this germination problem and to minimize gaps as well as yield loss Spaced Transplanting technique (STP) was developed at this laboratory (Rahman and Rahman, 1979). In this technique sugarcane settlings are raised at polybag and soilbed nursery as well as standing sugarcane (called rayungan settlings) and 6-8 weeks old settlings are transplanted at the main field at a desired distance. This technique solved field germination problem, minimized gaps in the field, and increased cane yield. However, this technique has inbuilt limitation as well. STP technique is laborious and labour intensive and transportation of STP settlings are relatively costly. To make STP technique cost effective and easy, the present investigation was undertaken to prepare stalkless settlings by hormone treatment through easy transportation from nursery to main field.

MATERIALS AND METHODS

An investigation was conducted at Physiology laboratory of the Bangladesh Sugarcane Research Institute (BSRI) during cropping season 2000-2001. Two types of sugarcane settlings (shoots) such as Polybag settlings and soilbed settlings were raised using three selected varieties (Isd 2/54, Isd 28 and Amrita). Polybag settlings and soilbed settlings were grown at nursery. Six to eight weeks old settlings (15-20 cm long) of said varieties were used as test materials and separated from stalks (Fig. A). Selected settlings were soaked for 12, 24 and 36 h in three different hormones (NAA, IBA and IAA) of different concentrations (0.2, 0.5, 1.0, 2.0 and 5.0 mg l^{-1} water) for rooting enhancement in hormone treated settlings(Fig. B). After soaking of stalkless settlings (shoots) in hormone solutions, soaked settlings were planted in the plastic tray having field soils as well as in the main field at two moisture regimes. Water was applied at planting, and 3 days after transplanting. It was also tested at soil moisture stress condition. After 10 days of transplanting, the settlings of both plastic tray and soil bed nursery were uprooted and data collected on root initiation, number of root/shoot, root length and fresh root weight.

RESULTS AND DISCUSSION

In the present investigation trials were carried to enhance root initiation in sugarcane stalkless settlings by hormone treatments and tested at two moisture regimes. The results have been presented in the tables 1 and 2. It is seen from the table 1 that NAA, IBA and IAA hormone treatment have positive impact on root initiation from root premordia of sugarcane settlings. It is also seen from the table 1 that NAA was found to be superior over IBA and IAA at all three soaking periods in respect to survival rate, days to root initiation, root length and fresh weight at optimum soil moisture regime(Fig. C). However, both NAA and IBA took 4 d to initiate rooting in hormone treated stalkless settlings. The table 1 shows that among five concentrations used 2 mg l^{-1} NAA showed the best performance followed by 2 mg l^{-1} IBA in respect to settlings survival per cent, days to root initiation, roots production (number) and root growth (length) at all three soaking periods(Fig. D). The table 1 also shows that increase of soaking period have no positive impact in case of all three hormones (NAA, IBA and IAA) in respect to different parameters tested, and among three soaking periods, 24 h soaking was found relatively better compared to 12 h and 36 h of soaking.

After 10 days of plantation, number of roots, root length and fresh root weight of the transplanted settlings were found higher at 24 h soaking in 2 mg l^{-1} NAA hormone solution compared to 12 and 36 h soaking periods. The lowest survivability of transplanted settlings (65%) was recorded at 0.2 mg l^{-1} NAA treatment and took 5 d for root initiation. Higher concentrations of NAA (2 or 5 mg l^{-1}) increased survivability (100%) of transplanted settlings in the field than lower concentrations (0.2 mg l^{-1} for 65% or 0.5 mg l^{-1} for 78%). Same survivability per cent was recorded at 2 mg l^{-1} and 5 mg l^{-1} NAA treatment at 24 h soaking period but the number of roots and its fresh weight were found higher at 2 mg l^{-1} (9.20 & 2.58gm respectively) than 5 mg l^{-1} (8.35 & 2.36 gm respectively). The highest (95%) settlings survivability was recorded when settling were soaked in IBA solution of 2 mg l^{-1} concentration, and took 3 d to initiate rooting compared to rest concentrations. Higher concentration of IBA (5 mg l^{-1}) decreased survivability of transplanted settlings. Banik *et al.* (1995) recorded 100 ppm IBA to induce root in hybrid Acacia, and these findings are supported by the present findings. Earlier and higher root induction was recorded in settlings soaked in 2mg l^{-1} IBA solution.

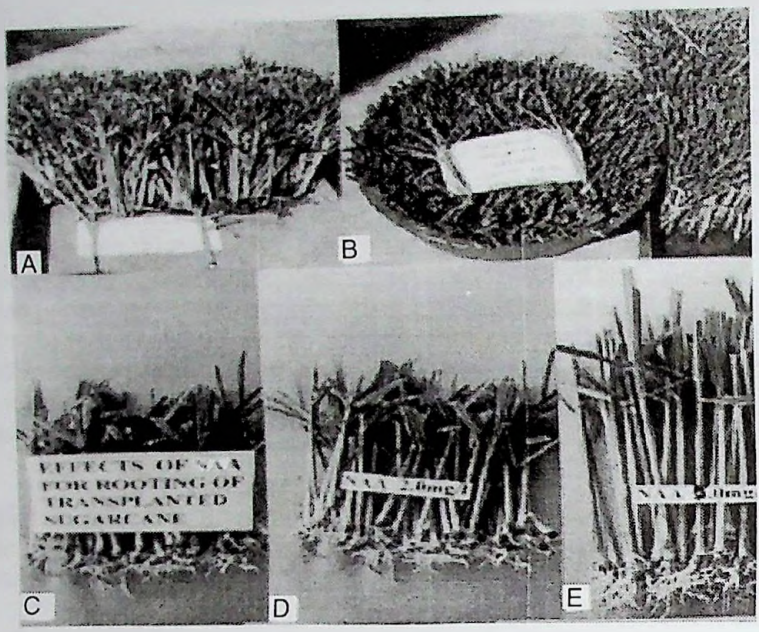

Figure: A : Stalkless settlings ready for hormone treatment
B : Soaking of settlings in hormone solution
C : Transplanted hormone (NAA) treated stalkless settlings were uprooted after 10 d of planting
D : Transplanted NAA 2.0 mg l^{-1} treated stalkless settlings were uprooted after 10 d of plantation at field soil moist condition.
E : Transplanted NAA 5.0 mg l^{-1} treated stalkless settlings were uprooted after 10 d of plantation at soil moisture stress condition.

Rooting potential in transplanted settlings through IAA 1 and 2 mg l^{-1} solutions at 24 h soaking gave the highest survivability (75%) of transplanted settlings, However, this survival per cent was found to be lower compared to survival per cent of NAA or IBA treated settlings.

Table 1. Effects of different concentrations of NAA, IBA and IAA and soaking periods on rooting from sugarcane settlings in the field at optimum soil moisture regime.

Hormone (mg l^{-1})	Survival rate(%)	Days to root initiation			No. of roots/shoot			Root length (cm)			Fresh roots weight (gm)		
		Soaking Period			Soaking Period			Soaking Period			Soaking Period		
		12 h	24 h	36 h	12 h	24 h	36 h	12 h	24 h	36 h	12 h	24 h	36 h
Control	52	6	6	6	3.30	3.30	3.30	4.18	4.18	4.18	1.52	1.52	1.77
NAA 0.2	65	6	5	5	4.68	5.30	5.40	5.85	5.48	5.35	1.73	2.25	2.15
0.5	78	5	5	5	6.63	6.70	6.90	5.98	5.95	5.90	2.34	2.20	2.57
1.0	90	5	4	4	5.57	7.60	6.48	5.30	6.25	5.25	1.95	2.45	1.75
2.0	***100***	***4***	***3***	***3***	***8.61***	***9.20***	***8.25***	***6.57***	***6.64***	***6.67***	***2.60***	***2.58***	***2.54***
5.0	100	4	3	3	7.84	8.35	7.28	5.61	6.31	5.92	2.16	2.36	1.86
Mean	**86.6**	**4.8**	**4.0**	**4.0**	**6.67**	**7.4**	**6.9**	**5.9**	**6.1**	**5.8**	**2.2**	**2.4**	**2.2**
IBA 0.2	62	6	5	5	4.71	4.81	4.65	3.77	4.35	3.95	1.25	1.28	1.45
0.5	75	5	5	5	5.80	5.43	5.92	4.18	4.85	4.08	1.44	1.50	1.42
1.0	90	5	4	4	6.20	6.23	6.05	5.35	5.30	4.84	2.32	2.14	1.64
2.0	***95***	***4***	***3***	***3***	***6.50***	***6.98***	***6.32***	***5.89***	***6.25***	***5.67***	***2.45***	***2.36***	***1.98***
5.0	80	4	3	3	5.14	5.88	4.74	4.38	4.60	3.46	1.68	1.68	1.72
Mean	**80.4**	**4.8**	**4.0**	**4.0**	**5.7**	**5.9**	**5.5**	**4.7**	**5.1**	**4.4**	**1.8**	**1.8**	**1.6**
IAA 0.2	59	6	6	6	3.48	3.45	3.57	3.24	3.65	3.29	1.00	0.95	0.87
0.5	72	6	5	5	3.90	3.80	3.65	3.85	4.02	3.17	1.32	1.15	1.20
1.0	75	5	5	4	4.60	4.65	4.25	4.65	4.56	3.78	1.55	1.84	1.41
2.0	75	5	4	4	4.90	5.22	4.63	4.97	4.85	4.63	1.98	2.32	1.64
5.0	54	4	4	4	3.26	3.27	3.13	4.53	3.70	2.95	1.27	1.86	1.31
Mean	**67.0**	**5.2**	**4.8**	**4.6**	**4.0**	**4.1**	**3.9**	**4.3**	**4.2**	**3.6**	**1.4**	**1.6**	**1.3**

Three varieties were tested and no significant variation among varieties were recorded. As such instead of showing varietywise data, representative results have been shown in the table 1.

Results of trials carried out at soil moisture stress condition have been shown in the table 2. It is seen from the table 2 that at soil moisture stress condition, the highest (64%) survivability of settlings was recorded when settlings were soaked in 5 mg l^{-1} NAA solution for 24 h (Fig. E) . Shukla *et al.*(1994) and Barba *et al.*(1977) used 5 mg l^{-1} NAA to initiate rooting in *in vitro* grown sugarcane plantlet. In the present investigation, when transplanted settlings were soaked at 5 mg l^{-1} IAA solution for 24 h failed to induce rooting although poor rooting responses was observed in case of 5mg l^{-1} IBA. Present findings support earlier report published elsewhere (Lal, 1992). He reported that Naphthalene acetic acid (NAA) was the most suitable auxin for rooting in sugarcane.

Cost-benefit analysis of stalkless settling compared to conventional polybag and soilbed settlings have been shown in the table 3. Minimum weight of a single budded 50 d old soilbed settlings were estimated to be 50 gm and as such weight of 10 thousand soilbed settlings were about 500 kg. Transportation of these settlings from nursery to main field costs about Tk 300-400 depending on distance between settling nursery and main field. A labour can transplant about 2000 soilbed settlings in a day, so for transplanting of

10 thousands settlings needs 5 labourer. The weight 50 d old polybag (with soil) settlings was estimated to be about 300 gm. So weight of 10 thousand polybag settlings was about 3000 kg. Transportation costs of 10 thousand polybag settlings varies between Tk. 900 - 1200. A labour can transplant about 500-600 polybag settlings in a day, so transplanting of 10 thousand polybag settlings needs 17-20 labourers. It is seen from the table 3 that treatment of 10 thousand polybag settlings with hormone cost only Tk 16, and got 214 kg waste stalk for fuel. After separation of settlings from stalks, weight of 10 thousand settlings were 60 kg only, so it was easy to transport from nursery to main field. A labourer can transplant 5000 settlings in a day that reduced the cost of sugarcane cultivation.

Table 2. Effects of different concentrations of NAA, IBA and IAA, and soaking periods on rooting from sugarcane settlings in the field (at soil moisture stress regime).

Hormone mg l^{-1}	Survival rate(%)	Days to root initiation			No. of roots/shoot			Root length (cm)			Fresh roots weight (gm)		
		12 h	24 h	36 h	12 h	24 h	36 h	12 h	24 h	36 h	12 h	24 h	36 h
Control	20	7	7	7	2.20	2.20	2.20	3.15	3.15	3.15	0.72	0.72	0.72
NAA 0.2	25	7	6	6	3.35	3.27	3.21	4.29	4.45	3.65	1.13	1.08	1.00
0.5	30	7	6	6	3.42	3.65	3.50	4.76	5.11	4.58	1.44	1.26	1.28
1.0	42	6	5	5	4.16	4.03	4.25	5.11	5.97	5.07	1.46	1.31	1.43
2.0	50	5	5	5	4.58	4.62	4.63	5.98	5.65	5.41	1.62	1.45	1.39
5.0	*64*	*5*	*4*	*4*	*4.85*	*5.35*	*5.08*	*6.32*	*6.25*	*5.72*	*2.05*	*2.31*	*1.88*
Mean	42.2	6.0	5.2	5.2	4.1	4.2	3.3	5.3	5.5	4.9	1.5	1.5	1.4
IBA 0.2	22	7	7	7	1.66	2.12	2.05	3.27	2.64	3.62	1.00	1.18	1.05
0.5	25	7	6	6	2.15	2.65	2.35	3.58	3.18	3.85	1.21	1.06	1.21
1.0	35	6	6	6	2.38	3.11	1.87	3.82	3.96	2.93	1.28	1.35	1.06
2.0	40	6	5	5	2.55	3.08	2.43	3.68	4.14	3.45	1.22	1.41	1.25
5.0	33	6	5	5	1.87	4.52	2.36	4.11	4.61	3.88	1.01	1.81	1.30
Mean	31	6.4	5.8	5.8	2.1	3.1	2.2	3.7	3.7	3.5	1.1	1.4	1.2
IAA 0.2	25	7	7	7	1.08	1.90	1.25	2.15	2.50	2.37	0.60	0.81	0.73
0.5	30	7	6	6	1.26	2.11	1.50	2.65	2.82	2.84	0.82	0.86	0.95
1.0	33	7	6	6	1.54	2.19	1.88	2.72	3.20	3.00	0.77	1.15	1.00
2.0	38	6	5	5	1.82	1.96	2.30	2.64	3.71	3.40	0.68	0.98	1.12
5.0	0	-	-	-	-	-	-	-	-	-	-	-	-
Mean	25.2	6.8	6.3	6.3	1.1	1.6	1.2	2.0	2.4	2.3	0.6	0.8	0.8

Three varieties were tested and no significant variation among varieties were recorded. As such instead of showing varietywise data, representative results have been shown in the table -2.

Table 3. Cost-benefit analysis between stalkless hormone treated STP settlings and conventional untreated STP settlings (Ten thousand settlings were used in this analysis)

Sources of settlings	Weight (kg)	Cost of transportation (Taka)	Cost of hormone (Taka)	Fuel from waste stalk (kg)
Conventional untreated Soil bed Settlings	500	300-400		
Hormone treated Soil bed Settlings	60	40-50	16	214
Conventional untreated Polybag Settlings	3000	900-1200		
Hormone treated Polybag Settlings	60	40-50	16	214

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