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Effect of growth regulators on growth, yield and quality of *Sewan* grass (*Lasiurus sindicus* Henr.)

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Abstract
A field experiment was conducted during *Kharif*, 2011, 2012 and 2013 for consecutive three years at Agricultural Research Station, S.K. Rajasthan Agricultural University, Bikaner to study the effect of growth regulators on growth, yield and quality of *Sewan* grass. The experiment was laid out in randomized block design and replicated thrice. Results showed that maximum plant height (80 cm), total tiller/m row length (174), spike length/plant (8.25 cm) and test weight (2.76 g) was recorded with salicylic acid (100 ppm) seed soaking + thiourea (0.05%) foliar spray. Highest seed (15.35 q/ha) and grass (40.89 q/ha) yield of *Sewan* grass was recorded with thiourea seed soaking + salicylic acid (100 ppm) foliar spray and maximum values of sustainability yield index was recorded with thiourea soaking + salicylic acid (100 ppm) spray for grass yield (37.25%) and with salicylic acid (100 ppm) soaking + no spray for seed yield (7.68%). Further, crude protein (10.11%), crude fibre (33.25%) and total ash (6.04%) content were recorded maximum with thiourea seed soaking + thiourea (0.05%) foliar spray.

Keywords: Crude protein, Foliar spray, Grass yield, Growth regulator, Seed yield

Introduction

Grasses and their values have been recognized since time immemorial as the present day cereal crops are the cultivated varieties of their wild ancestors. Use of grasses, as food resources or as fodder has led to extensive breeding programs and improvement in pasture land (Hazra, 2014). *Lasiurus sindicus* (*Sewan*) is the primary grass of extremely arid parts of Jaisalmer, Barmer and Bikaner districts of western Rajasthan in the 'Indian Thar Desert'. It thrives well under moisture stress on sandy plains, low dunes and hummocks of this region, receiving annual rainfall below 200 mm. In arid regions there is nothing more effective than the grass to immobilize the moving sand. A drought resistant grass with a stoloniferous habit, a rapid rate of growth and branching and a good soil binding system is essential for soil conservation on loose sands. Under arid conditions, the rainfall and grazing practices limit the growth, vigour and productivity of grasses to a very great extent. Years with good rainfall show vigorous growth of grasses while under drought conditions the growth is very poor, thus affecting the productivity to be minimum. In India concept of scientific pasture management has not been properly planned, despite the fact that India has one of the largest livestock populations in the world, with an estimated 520 million heads. Efforts in India for pasture management have been confined either to improvement of existing grasslands or introduction of suitable exotics. There is no sound management plan for the development of pasture land and protection of existing patches of grassland, some of which are unique and harbour rich fauna. Not much attention so far has been focused on improving plant biology, more particularly plant molecular mechanisms which inherently influence not only acquisition of water and nutrient from the soil but they also govern their transport inside the plants and thus these are efficient in improvement of plant performance and yield formation in arid ecosystem. Foliar spray of growth regulators improves phloem translocation of photosynthate and crop productivity (Giaquinta, 1976; Sahu *et al*., 1993; Srivastava *et al*., 2008). Thus, they play an important role in improving water use efficiency through enhanced phloem translocation and yield formation in arid regions. The information on seed soaking and foliar spray of growth regulators *viz.,* thiourea, and salicylic acid on *Sewan* grass growth and yield are meager. Hence, there is a felt need to generate precise information on effect of growth regulators on growth, yield and quality of *Sewan* grass.

Materials and Methods

A field experiment on *Sewan* grass was conducted for consecutive three years during *Kharif* season of 2011, 2012 and 2013 at Agricultural Research Station, S.K. Rajasthan Agricultural University, Bikaner situated in arid western hyper arid zone of Rajasthan. The soil of exper-

-imental field was sandy loam in nature, having bulk density 1.51 g /cc, pH (1:2) 8.09, and electrical conductivity (1:2) 0.9 dS/m. The soil was very low in organic carbon (0.12%), available nitrogen (89 kg/ha), medium in available P (15.6 kg/ha) and medium in available K (235.7 kg/ha). Total rainfall during the crop seasons were 249, 209 and 198 mm received in 14, 15 and 16 rainy days in respective years 2011, 2012 and 2013. The experiment was laid out in randomized block design and replicated thrice. The experiment consists of 12 treatments combinations for seed soaking and foliar spray *viz.,* water soaking + no spray, water soaking + water spray, water soaking + thiourea (0.05%) spray, water soaking + salicylic acid (100 ppm) spray, thiourea soaking + no spray, thiourea soaking + water spray, thiourea soaking + thiourea (0.05%) spray, thiourea soaking + salicylic acid (100 ppm) spray, salicylic acid (100 ppm) soaking + no spray, salicylic acid (100 ppm) soaking + water spray, salicylic acid (100 ppm) soaking + thiourea (0.05%) spray and salicylic acid (100 ppm) soaking + salicylic acid (100 ppm) spray. Foliar spray of growth regulators (as per treatment) was done at panicle initiation stage using 500 litres of water per ha. *Sewan* grass "local selection" was sown with the receipt of good monsoon rains (30th July) in *Kharif*, 2011 using 6 kg seed/ha with row to row 75 cm and plant to plant 50 cm spacing. Seed (6 kg) was mixed with moist soil of the same field (1:5 ratio) immediately before sowing in such a way that each crunch of the mixture of soil contains 7-10 seeds. The crunch of seed-soil mixture was dibbled at 1-2 cm depth keeping proper crop geometry. During subsequent years (2nd and 3rd year) the same crop stand was used for treatment application and for taking observations for yield and yield attributes and evaluation of quality parameters. Only lifesaving irrigation was applied during long dry spell. *Sewan* grass was harvested 30-40 days after panicle emergence when matured caryopsis with husk starts dropping after attaining physiological maturity from the upper end of panicle. Harvesting of seed was done by hand picking of matured panicle or sometimes individual matured caryopsis. All the cultural operations *viz*., basal dose of fertilizer *i.e*. 20 kg nitrogen, 30 kg P_2O_5 per hectare followed by hoeing during July and weeding and broad casting of 15 kg Urea in mid of August months were carried out during every season. For the determination of crude protein percentage, nitrogen percentage was multiplied with 6.25. Crude fibre (%) and total ash (%) was determined by adopting AOAC (1992) method with the following formulae.

$$\text{Crude fiber (\%)} = \frac{W_2 - W_3}{W_1} \times 100$$

Where, w_1, weight of sample; w_2, weight of silica crucible + residue (after oven drying *i.e.* before ashing) and w_3, weight of silica crucible + residue (after ashing).

$$\text{Total ash (\%)} = \frac{W_3 - W_2}{W_1} \times 100$$

Where, w_1, weight of sample; w_2, weight of silica crucible and w_3, weight of silica crucible + ash.

Further, sustainability yield index was calculated using the following formula:

$$\text{Sustainability yield index (\%)} = \frac{\bar{y} - S\sigma}{Ymax} \times 100$$

Where, $'\bar{y}'$ is mean yield, $'S\sigma'$ is standard deviation and *Ymax* is maximum yield.

Results and Discussion

***Yield attributes*:** Seed soaking and foliar spray of growth regulators had significant effect on plant height and yield attributes *viz*., total tiller/m row length, spike length/plant and test weight of *Sewan* grass during each year of investigation. The mean maximum plant height (80 cm), total tiller/m row length (174), spike length/plant (8.25 cm) and test weight (2.76 g) was recorded with salicylic acid (100 ppm) seed soaking + thiourea (0.05%) foliar spray. However, salicylic acid (100 ppm) seed soaking + thiourea foliar spray, water soaking + thiourea (0.05%) spray, water soaking + salicylic acid (100 ppm) spray, thiourea soaking + thiourea (0.05%) spray, thiourea soaking + salicylic acid (100 ppm) spray and salicylic acid (100 ppm) soaking + salicylic acid (100 ppm) spray gave at par plant height of *Sewan*, whereas salicylic acid (100 ppm) seed soaking + thiourea foliar spray, thiourea soaking + thiourea (0.05%) spray and thiourea soaking + salicylic acid (100 ppm) spray were at par for total tiller/ m row length, spike length/plant and test weight (Table 1). Kumawat and Gangopadhyay (2013) was of the opinion that increment in growth and yield contributing characters of *Sewan* grass might be due to the fact that seed soaking and foliar spray of growth regulators improved photosynthetic efficiency, thereby more accumulation of photosynthates, which in turn resulted maximum plant height and yield attributes. Sahu *et al.* (1993) reported that foliar spray of thiourea significantly increased growth and yield attributes of maize, most probably via improvement in the photosynthetic efficiency and canopy photosynthesis. Giaquianta (1976 and 1977) also suggested the involvement of sulphahydyl group in phloem transport of sucrose. Recently at BARC under laboratory conditions these evidences was further supported in *Brassica juncea* (Srivastava *et al*., 2008). The translocation of 14C-sucrose to the different parts of the mustard (*Brassica juncea*) crop has been evaluated in the context of understanding the source to sink relation-

-ship in the thiol-induced enhanced crop yield. The foliar application of thiols like TU, TGA and DTT to the plant gave maximum sucrose phosphate synthase activity, which was found to have direct correlation with the movement of sucrose. The distribution pattern of 14C-sucrose follows the path from internode and node to pod via leaf. The translocation of 14C-sucrose was found to be a light dependent process. Among the nucleotides ATP and GTP, only ATP was able to promote the translocation and GTP was ineffective. In this unique *in situ* tracer experiment using 14C-sucrose, it was established that thiols are able to enhance the translocation of sucrose from source to sink.

Table 1. Effect of growth regulators on growth and yield attributes and quality of *Sewan* grass (pooled over mean data of three years)

Treatment	Plant height (cm)	Tiller/m row length (no.)	Spike length (cm)	Test weight (g)	Crude protein (%)	Crude fibre (%)	Total ash (%)
T_1	73.96	147.0	5.50	2.58	7.97	27.97	4.79
T_2	76.25	157.5	5.80	2.60	8.02	28.02	4.91
T_3	77.41	162.0	6.57	2.63	8.86	31.60	5.16
T_4	77.24	160.5	5.74	2.65	8.55	31.29	4.85
T_5	75.89	149.7	5.93	2.64	8.89	32.03	5.19
T_6	76.45	158.1	7.13	2.63	9.05	32.19	5.35
T_7	78.16	163.9	7.45	2.70	10.11	33.25	6.04
T_8	79.02	165.9	7.69	2.75	9.92	33.06	5.89
T_9	76.08	154.9	6.60	2.65	8.87	32.01	5.17
T_{10}	76.99	161.5	7.05	2.66	9.02	32.16	5.32
T_{11}	79.52	174.2	8.25	2.76	9.52	32.66	5.82
T_{12}	77.68	164.6	6.58	2.66	9.44	32.58	5.74
SEm $\pm$	1.06	4.57	0.36	0.03	0.53	0.54	0.91
CD ($P \leq 0.05$)	2.50	10.8	0.85	0.06	1.26	1.27	NS

Table 2. Effect of growth regulators on seed yield , dry grass yield and sustainability yield index of *Sewan* grass

Treatment	Grass yield (q/ha)				Seed yield (q/ha)				Sustainability yield index (%)	
	2011	2012	2013	Mean	2011	2012	2013	Mean	Grass	Seed
T_1	19.60	39.36	17.57	25.51	2.31	6.94	19.07	9.44	34.23	4.12
T_2	29.77	60.24	21.76	37.25	2.43	7.16	25.90	11.83	28.14	-2.25
T_3	30.77	61.02	24.08	38.62	2.81	8.28	30.33	13.81	31.04	-2.51
T_4	30.37	60.66	23.93	38.32	2.67	7.92	30.67	13.75	30.84	-3.69
T_5	30.37	61.02	21.80	37.73	2.78	8.20	23.40	11.46	28.04	3.29
T_6	30.17	60.71	25.63	38.83	2.89	8.71	25.73	12.44	32.55	2.23
T_7	29.87	60.42	28.73	39.67	2.96	8.69	32.61	14.75	35.91	-2.99
T_8	30.90	61.61	30.17	40.89	3.50	10.68	31.87	15.35	37.25	1.88
T_9	29.93	60.14	21.50	37.19	3.12	9.40	22.70	11.74	28.06	7.68
T_{10}	30.37	61.10	25.75	39.07	3.07	9.34	24.50	12.30	32.50	5.25
T_{11}	31.03	62.14	27.07	40.08	3.43	10.46	32.13	15.34	33.59	1.18
T_{12}	29.97	60.16	26.47	38.87	2.84	8.68	31.43	14.32	33.82	-2.51
SEm $\pm$	0.76	0.63	2.62	1.36	0.07	0.13	0.50	0.23	-	-
CD ($P \leq 0.05$)	2.15	1.85	7.72	3.91	0.20	0.38	1.45	0.68	-	-

Note: T_1, Water soaking + No spray; T_2, Water soaking + Water spray; T_3, Water soaking +Thiourea (0.05%) spray; T_4, Water soaking + Salicylic acid (100 ppm) spray; T_5, Thiourea soaking + No spray; T_6, Thiourea soaking + Water spray; T_7, Thiourea soaking + Thiourea (0.05%) spray; T_8, Thiourea soaking + Salicylic acid (100 ppm) spray, T_9, Salicylic acid (100 ppm) soaking + No spray; T_{10}, Salicylic acid (100 ppm) soaking + Water spray; T_{11}, Salicylic acid (100 ppm) soaking + Thiourea (0.05%) spray; T_{12}, Salicylic acid (100 ppm) soaking + Salicylic acid (100 ppm) spray.

***Yield and sustainability yield index*:** Seed and grass yield of *Sewan* grass were also significantly influenced due to seed soaking and foliar spray of growth regulators during the period of research. The highest mean *Sewan* seed (15.35 q/ha) and dry grass yield (40.89 q/ha) were recorded with thiourea seed soaking + salicylic acid (100 ppm) foliar spray. However, thiourea soaking + salicylic acid (100 ppm) spray, thiourea soaking + thiourea (0.05%) spray and salicylic acid (100 ppm) soaking + thiourea spray gave at par seed yield, whereas grass yield was at par with rest of the treatments except water soaking + no spray (Table 2). In Maize, Sahu and Solanki (1991) and in arid zone crops (Sahu *et. al*., 2006) reported that foliar spray of sulphydryl compounds improved dry matter partitioning and grain yield with considerable improvement in harvest index. Seed soaking with thiourea (500 ppm) significantly increased biological yield of maize and had noticeable effect on seed yield as well (Sahu *et al*., 1993). Foliar spray of thiourea (500 ppm) also significantly improved dry matter partitioning, harvest index and seed yield of wheat (Sahu and Singh, 1995) in maize (Sahu *et al*., 2006) and in mustard (Srivastava *et al*., 2008). Further, maximum values of sustainability index was recorded with thiourea soaking + salicylic acid (100 ppm) spray for grass yield (37.25%) and with salicylic acid (100 ppm) soaking + no spray for seed yield (7.68%) of *Sewan* grass due to consistent yields recorded over years.

***Quality*:** The study on seed soaking and foliar spray of growth regulators indicated that quality parameters *viz.* crude protein (10.11%), crude fibre (33.25%) and total ash (6.04%) content were recorded maximum with thiourea seed soaking + thiourea (0.05%) foliar spray. However, thiourea soaking + no spray, thiourea soaking + water spray, thiourea soaking + thiourea (0.05%) spray, thiourea soaking + salicylic acid (100 ppm) spray, salicylic acid (100 ppm) soaking + no spray, salicylic acid (100 ppm) soaking + water spray, salicylic acid (100 ppm) soaking + thiourea (0.05%) spray and salicylic acid (100 ppm) soaking + salicylic acid (100 ppm) spray gave at par values of crude protein and fibre, whereas total ash content of *Sewan* showed non significant variation with seed soaking and foliar spray of growth regulators (Table 1). Kumawat and Gangopadhyay (2013) suggested that growth regulators improved accumulation of photosynthates and photosynthetic efficiency through translocation of carbon towards sink directly or indirectly with enhanced uptake of nutrients (both macro and micro nutrients) from the soil due to more growth, vigour and competitive ability of plant under harsh climatic conditions. Further, higher uptake of nutrients like nitrogen, phosphorus etc, and the higher protein yield was a resultant of improved quality parameters *viz*., crude protein, crude fibre and total ash content of the plant.

Conclusion

Seed soaking followed foliar spray with growth regulators *viz*., salicylic acid or thiourea and *vice versa,* results in improvement of yield attributes, yield and quality parameters compared to water treatment (control). Maximum yield attributes *viz*., plant height (80 cm), total tiller/m row length (174), spike length/plant (8.25 cm) and test weight (2.76 g) was observed with salicylic acid (100 ppm) seed soaking + thiourea (0.05%) foliar spray. The highest seed yield (15.35 q/ha) and dry grass yield (40.89 q/ha) was recorded with thiourea seed soaking followed salicylic acid (100 ppm) foliar spray. While in grass crude protein content (10.11%), crude fibre (33.25%) and total ash (6.04%) content were noted maximum with thiourea seed soaking + thiourea (0.05%) foliar spray.

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