PRUNING HEIGHT AND ITS EFFECT ON QUANTITATIVE AND QUALITATIVE SEED PRODUCTION IN OLD SAXUAL (*Haloxylon aphyllum*) FORESTS OF YAZD, IRAN

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Abstract

The high quality and quantity seed production in old saxual shrubs are essential for regeneration and sustainable development of saxual forests in desert areas. The objective of this study was to determine the effects of different pruning height on saxual seed production. The study was carried out in an obviously wilted saxual forest located in Ashkezar desert in Yazd in 1994. The experiment was carried out in a split-plot design with 3 replications, with saxual density (250 and 125 shrubs/ha) as the main plots, and pruning height (10, 35, 70 cm, and a no-cut check) as the sub-plots. Pruning was done on autumn 1994. The forest was protected completely and the quality and quantity of seed production of marked shrubs were investigated on autumn 1999 and 2000. The 2-year results showed that saxual density did not have any significant effect on quality and quantity of saxual seed production ($P<0.05$). Pruning height had significant effect on percent seed longevity and net saxual seed production ($P<0.05$). Although no significant difference was observed in viable net seed production under different pruning height, the amount of viable net seed production at 35cm pruning height was 9.7 kg/ha, which seems adequate for saxual regeneration.

Key words: Saxual (*Haloxylon aphyllum*), Forest, Pruning, Seed quality, Seed quantity.

Introduction

Sand deserts cover 13 millions ha of total area in Iran of which 40% is considered as active and semi-active sand dunes (Ekhtesasi et al., 1996). Storm, sand movement, and desertification are always the main problems in these regions and surrounded areas. As a result, combating the source area and preventing desertification were started by biological methods in 1959. It included the plantation of saxual in sand covered areas. Saxual is cultivated on 2 millions ha (Jariani et al., 2003) of the country of which one tenth is in Yazd province (Anonymous, 2003).

Although saxual is amongst the most adaptive plant species in this region, but the shrubs wilted in Sabzevar after 5-6 years of their cultivation time and this extended to other regions of the country rapidly (Amani et al., 1996). Pests like *Proceratia caesariella*,

Prorophora albidugilvella, and *Holcocerus tancrei* also threat saxual shrubs in the region too (Abaii, 2000 and Shamszadeh et al., 1998). Many reports have indicated the beneficial effects of pruning on freshness, increasing longevity and stimulating growth of saxual. Alizadeh (Alizadeh, 1981) reported that episodic growth of pruned shrubs was two times that in check shrubs (non-pruned shrubs). Amani and Parvizi (Amani et al., 1996) suggested pruning at ground level to increase saxual shrubs longevity and growth. Baghestani Maybodi et al. (Baghestani Maybodi et al., 2004) studied different pruning height in saxual forests in Yazd under two planting density (250 and 125 shrubs/ha). They concluded that planting density did not have any significant effect on saxual shrubs growth, while pruning the shrubs at 35cm from ground level had significant positive effect on their growth. Although its positive effects on growth stimulation of saxual shrubs, Shamszadeh and Baghestani Maybodi (Shamszadeh et al., 2003) reported that pruning did not have any significant reductive effect on saxual infection to *Proceratia caesariella* compared to non-pruned shrubs, but no investigation had been performed on the quality and quantity of seed production in their study.

The objective of this study was to determine the effect of different pruning/ pruning height on the quantity and quality of seed production by old saxual shrubs in Ashkezar, Yazd.

Materials and methods

Experimental site

This study was conducted in a 12-years old saxual forest plantation in Ashkezar, Yazd, with saxual population density of 250 shrubs/ha. The region has the slope<2% and is 1140 meter above sea level which is covered by shifting sand dunes. The climate of this region is cold and arid based an Amberje climate classification, and hyper arid-cold according to De Martonne climate classification (Dashtakian et al., 2003), with 61.7mm annual precipitation. Mean annual temperature and absolute maximum and minimum temperatures of the region are 18.1, 46.5, and -15.5°C, respectively. The region is classified as bare land although some species like *Salsola tomentosa*, *Anabasis setifera*, *Artemisia sieberi*, *Stipagrostis plumosa*, and *Launea acanthodes* are grown randomly in very few populations (Baghestani Maybodi et al., 1992).

Treatments and data processing

The three hectares of saxual forest with obvious wilting symptoms was selected and protected in the first half of 1994. Saxual shrubs had been cultivated in 1983 with rows 8m apart and oriented against wind direction. Distance between two shrubs within each row was 5m, resulted in 250 shrubs/ha. The experiment was performed in a split-plot design with 3 replications. Saxual density (125 and 250 shrubs/ha) was allocated to the main plots, and pruning height (10, 35, 70Cm and no-cut as a check) was considered as

the sub-plots. To achieve 125 saxual shrubs/ha, the shrubs were eradicated every other one. The main plot size was selected big enough containing at least 10 shrubs for data collection sampling. The shrubs were cut in late November 1994, and then the forest was protected completely. In autumn 1995, at saxual seed production stage, the pruned shrubs were evaluated and necessary data were collected during 4 following years. After 5 years of shrubs pruning when their seed production were considerable, the quantity and quality of produced seeds were investigated in autumn 1999 and 2000. Three shrubs were selected at random in late November 1999 from each experimental plot and their seeds were collected. After air drying, seeds were separated from their wings by seed cleaner and weighed to obtain mean net seed weight per shrub. To determine seed longevity, 3 lots of 25 seeds were collected at random from harvested seeds in each plot and kept in 20°C for 8 days in germinator. Percent seed longevity was determined by dividing number of emerged seeds by total seed number. Multiplying net seed weight per shrub by seed longevity, net seed weight + wings was obtained, which is a criteria of seed quality. The same evaluation and measurements were performed in late November 2000. All data were analyzed as a split-plot design in time with the PROC GLM procedure using the SAS statistical software (SAS institute, 1996). Mean separation test was performed using Duncan multiple range test (DMRT).

Results and Discussion

Results of analysis of variance for seed longevity, net seed weight, and net viable seed weight are shown in Table 1. As it is observed, seed quantitative and qualitative parameters did not differ significantly between 250 and 125 saxual shrubs/ha (P<0.05). Climatic conditions also did not have any significant effect on the studied traits between two years of experiment. Pruning height had significant effect on sexual seed longevity and net seed weight (P<0.05), but not on net viable seed weight. Means of the studied traits based on the effects of sexual population density, year of experiment, and pruning height are shown in tables 2, 3, and 4, respectively.

Conclusion

Because seed production potential of pruned saxual shrubs is low in the first four years of their growth cycle, all evaluations and measurements were performed in the fifth and sixth years of saxual growth. As it was observed, the quantity and quality of produced seeds did not affected significantly by saxual population density (Table 2). So it can be concluded that increasing saxual density up to 250 shrubs/ha does not reduce seed quantity and quality, thus its production will be increased. But investigation on the effects of higher saxual densities on its seed quantity and quality should be also studied.

Table1: F-values for saxual seed longevity, net seed weight, and net viable seed weight in Yazd in 1999-2000

Source of Variation	F-value		
	Seed longevity (%)	Net seed weight (g)	Net viable seed weight (g)
Block (B)	0.326*	0.932	0.427
Saxual density (SD)	0.075	0.363	0.769
B*SD	0.066	0.197	0.743
Pruning height (CH)	0.026	0.024	0.180
CH*SD	0.187	0.057	0.166
B*CH (SD)	0.786	0.947	0.768
Year (Y)	0.209	0.363	0.372
SD*Y	0.429	0.373	0.998
B*Y (SD)	0.026	0.915	0.631
CH*Y	0.305	0.052	0.120
CH*SD*Y	0.546	0.743	0.971

* Numbers greater than 0.01 and 0.05 indicate no significant difference in 1 and 5% probability level according to F-test.

Table 2: Seed longevity, net seed weight, and net viable seed weight of saxual shrubs under 250 and 125 shrubs/ha in Yazd in 1999-2000.

Treatments	Means		
	Seed longevity (%)	Net seed weight (g)	Net viable seed weight (g)
250 saxual shrubs/ha	45.4±3.5 a*	98.5±14.3 a	42.8±7.1 a
125 saxual shrubs/ha	25.1±2.6 a	139.8±20.3 a	40.5±9.0 a

* Within each column, means followed by same letter are not significantly different at the 0.05 probability level according to DMRT test.

Table 3: Seed longevity, net seed weight, and net viable seed weight of saxual shrubs separately for each experimental year in Yazd.

Treatments	Means		
	Seed longevity (%)	Net seed weight (g)	Net viable seed weight (g)
1999	40.0±4.3 a*	125.5±15.9 a	46.7±7.9 a
2000	30.4±2.7 a	112.7±20.0 a	36.6±8.2 a

Within each column, means followed by same letter are not significantly different at the 0.05 probability level according to DMRT test.

Table 4: Seed longevity, net seed weight, and net viable seed weight of saxual shrubs at different pruning height in Yazd in 1999-2000.

Treatments	Means		
	Seed longevity (%)	Net seed weight (g)	Net viable seed weight (g)
Pruning at ground level	32.5±5.2 b*	73.8±17.2 b	24.4±6.3 a
Pruning at 10cm height	30.4±5.6 b	121.4±18.0 ab	38.8±10.6 a
Pruning at 35cm height	35.4±4.7 ab	125.5±20.1 a	46.2±11.3 a
Pruning at 70cm height	42.5±5.4 a	155.7±37.4 a	57.2±14.8 a

* Within each column, means followed by same letter are not significantly different at the 0.05 probability level according to DMRT test.

Mean annual precipitation in 1999 and 2000 were 94 and 10mm, respectively, which indicates a severe drought in the second year. Although saxual seed longevity, net seed weight, and net viable seed weight were affected by drought, but it caused no significant differences with those in 1999 (Table 2). Precipitation decreased 9 times in 2000 compared to 1999, while net seed weight was decreased only 22%. This indicates that saxual has the capability to continue seed production even under severe drought, which is a common phenomenon in the region. This is one of the positive characteristics of saxual in arid and desert regions. Check 18 years old saxual shrubs could not produce high amounts of seed, although pruned saxual shrubs could not increase the quantity and quality of their seed production either (Table 4). The results of the present study are not consistent with those in other studies, which had indicated the positive effect of pruning on increasing saxual seed production ability (Arabzadeh, 1995, Jamzad, 1992 and Valentine, 1990). It may be due to pruning effect which causes a shrub to allocate most of its production to vegetative growth than reproductive. The results of the present study also reveal that the pruned saxual shrubs are not able to increase their seed production more than that in non-pruned shrubs at least for the first six years after regrowth. Baghestani Maybodi et al. (Baghestani Maybodi et al., 2004) reported that pruning saxual shrubs at 35cm from ground level is the best approach to stimulate their growth. Shamszadeh and Baghestani Maybodi (Shamszadeh et al., 2003) also reported that pruning did not have any significant reductive effect on saxual infestation to *Proceratia caesariella*. Saxual seed yield pruned at 35cm from ground level with 250 shrubs/ha was 9.7 kg/ha, which seems adequate for saxual regeneration and well growth under optimum conditions. It also seems that the effect of pruning will be more relevant through time, so continuing the investigation for another next 5 years is recommended.

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