Response of Honey Mesquite Seedlings to Top Removal[1]

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Highlight

Honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*) seedlings formed branches from the cotyledonary axils within seven days after emergence when the aerial stems were removed and the cotyledons left intact. Foliar area was developed more rapidly where aerial stems were removed (from 2.6 to 3.5 cm^2/day) than on intact plants (2.2 cm^2/day). Seedling survival and number of branches formed per seedling increased as age increased prior to aerial stem removal. Normal branching occurred after top removal if portions of the cotyledons were left intact. Simultaneous removal of aerial stems and cotyledons of 10-day-old honey mesquites resulted in high seedling mortality and retarded branch formation.

To effectively control honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*), all parts of the plant capable of sprouting must be destroyed. Honey mesquite grows as a single-stemmed tree or a multiple-stemmed bush. The latter is probably stimulated after apical dominance is broken through top removal (Scifres et al., 1971). After top removal, mature honey mesquite plants sprout from a segment of enlarged, underground stem (Fisher et al., 1946). Top removal of small seedlings may occur due to freezing, desiccation, or by browsing of insects, wildlife, or domestic livestock before the young stems become woody. Honey mesquite seedlings do not survive when the aerial stem is excised below the cotyledons (Fisher et al., 1946; Meyer et al., 1971). Several perennial herbaceous species form buds from tissues below the cotyledonary axils (Meyers et al., 1964; Scifres and McCarty, 1969). Since this does not occur in honey mesquite, workers have hypothesized that the stem areas from the cotyledonary node upward must eventually form the underground "bud zone" (Meyer et al., 1971; Fisher et al., 1946). The objectives of this study were to (a) determine the growth period required before honey mesquite seedlings are capable of resprouting after top removal, (b) determine the morphological origin of new sprouts, and (c) investigate the relationship between honey mesquite seedling age and replacement of the terminal growth following top removal.

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Materials and Methods

Honey mesquite seeds collected in 1968 and 1969 near Spur, Texas were scarified prior to planting in a soil-vermiculite-sand (18:1:1) mixture in the greenhouse. The tops of one group of honey mesquite seedlings were removed 1 mm above the cotyledonary node at 7 days after emergence. Additional sets of seedlings were clipped at weekly intervals thereafter for 56 days. Another group of seedlings were treated in the same manner except the tops were removed 1 mm below the cotyledonary node. Evaluations were made 8 weeks following top removal of each age group.

In another segment of study, the cotyledons were excised from 10-day-old honey mesquite seedlings when the aerial stems were removed. Branch formation and leaf area development of these plants were compared to seedlings with the tops removed and the cotyledons left intact and with seedlings where only the cotyledons were removed. Other seedlings were included which had the seedling stem and one cotyledon removed, the stem and upper third, half, or two-thirds of each cotyledon removed, or the stem removed with the central, longitudinal half of each cotyledon left intact.

Morphological development of honey mesquite seedlings growing in glass-front boxes was observed as the studies progressed and substantiated by washing seedlings out of the soil periodically for inspection. Longitudinal, hand sections of seedlings from the cotyledonary node to the radicle were stained with safranin-0 in methonal for tracing of the vascular branches.

The number of days required for new sprouts to become visible, number of sprouts per plant, percentage of plants with sprouts, length of sprouts and leaf area were recorded at 7- to 10-day intervals. The method described by Wendt et al. (1967) was utilized for estimating leaf area per plant. The rate of leaf area development was estimated from the equation: $\hat{y} = a + b(x)$ where $\hat{y}$ is leaf area in cm^2, and b is the increase in leaf area per day over the growth period x. Production by seedling organs was determined by washing the seedlings out of the soil and dividing each into leaves, stem and roots. The plant organs were then oven dried and weighed.

The average high air temperature (87 F) occurred in the greenhouse by mid-afternoon and an average low of 66 F occurred around 8 a.m. Supplemental lighting was used for 12 hours on overcast days, otherwise the seedlings developed under daylight. Three to six replications of each treatment were arranged in randomized block design in all studies. Three to five seedlings were clipped per pot and each pot constituted an experimental unit. Each experiment was repeated three times.

Results and Discussion

Although the rate of development of honey mesquite seedlings varied among experiments, imbibition was always rapid and the radicle had usually emerged by 12 to 18 hours after planting. A noticeable collar of cortical tissues (collet) was obviously separating the radicle and hypocotyl within 48 hours. The seedlings usually emerged shortly after the collet was visible. By the third or fourth day, the cotyledons were fully expanded and the epicotyl was prominent. The first leaf, with a rachis about 7 mm long and 12 leaflets, was extended within 6

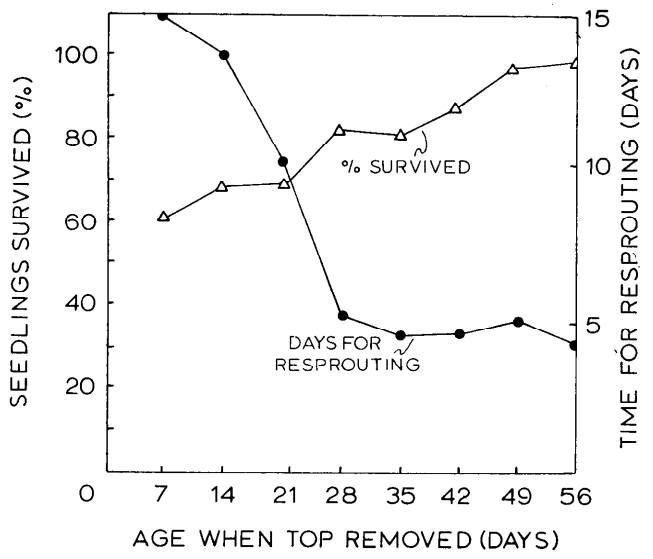

FIG. 1. Percentage of honey mesquite seedlings surviving and days required for resprouting after top removal.

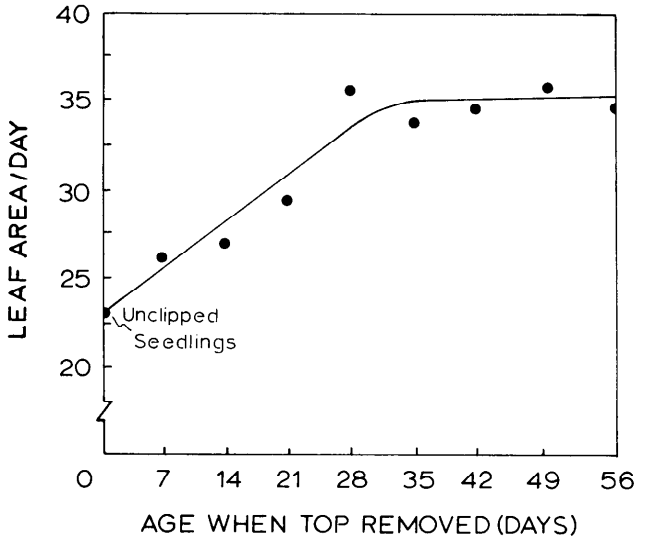

FIG. 2. Rate of increase in (cm^2/day) leaf area on honey mesquite seedlings during an 8-week growth period following top removal at the ground line.

to 8 days after planting. Elongation of the hypocotyl usually ceased by the twelfth day followed by rapid elongation of the epicotyl.

Effect of Age on Regeneration

About 60% of the 7-day-old seedlings survived top removal above the cotyledons (Fig. 1). However, no honey mesquite seedlings survived, regardless of age, when the tops were removed below the cotyledons. Less time was required for formation of new branches following top removal as age of seedlings increased. All seedlings with tops removed 7 weeks post-emergence formed new sprouts. All new branches, regardless of seedling age at top removal, were formed from the cotyledonary axils. Vascularization to the cotyledonary axils was obvious, but no branching occurred in the regions separating the radicle and cotyledonary node. The potential for honey mesquite seedlings to replace the terminal stems with more than one branch increased with age (Table 1). The increase in branching was accompanied by a decrease in height at 56 days.

Table 1. Average number of sprouts, stem lengths (cm), and the ratio of shoot to root weights (oven dry) at 56 days following stem removal of various aged honey mesquite seedlings in the greenhouse.[1]

Age at top removal[2]	Sprouts per seedling	Stem length	Shoot : root
Check	1.0 a	17 a	0.99 a
7	1.5 ab	17 a	1.44 c
14	1.3 ab	15 ab	1.36 bc
21	1.5 ab	15 ab	1.27 abc
28	1.5 ab	13 ab	1.26 abc
35	1.6 abc	11 ab	1.15 ab
42	1.9 bcd	10 ab	1.08 ab
49	2.2 cd	8 b	1.10 ab
56	2.8 d	8 b	1.10 ab

[1] Means within a column followed by the same letters are not significantly different at the 5% level.
[2] Refers to number of days after first emergence.

Leaf measurements were not possible until the rachises were extended to at least 2 mm. Measurements were facilitated when the rachises were 6 to 8 mm long and each had 5 to 7 pairs of expanded leaflets. Leaf development was linear with time.

Unclipped seedlings developed an average of about 2.2 cm^2 leaf area per day from the second week, when first measurable leaves were apparent, to the final measurement at 8 weeks post-emergence (Fig. 2). Leaf area was replaced more rapidly on clipped honey mesquite seedlings than it developed on unclipped seedlings during 8-week growing period. An increase occurred in the rate of leaf area development with seedling age if the aerial stem was removed within 28 days following emergence. Seedlings with the aerial portion removed from 28 to 56 days after emergence replaced the foliage at approximately 3.5 cm^2/day. The increased shoot growth occurred even though root development was retarded on seedlings clipped at 7 to 14 days after emergence (Table 1). Shoot:root ratios of seedlings clipped at 21 days or older were not significantly different from unclipped plants.

Role of Cotyledons in Resprouting

The cotyledons normally abscissed at 15 to 20 days after emergence of the honey mesquite seedlings. When the stem was removed, the cotyledons were apparently functional until about 2 weeks

Table 2. Development of branches and leaf area (cm^2) two weeks after removal of the aerial stem and removal of portions of the cotyledons from honey mesquite seedlings in the greenhouse.

Treatment of aerial stem	Portions of cotyledons left intact	Development of foliage and branches[1]		
		Leaf area	Stems per seedling	Stem length (cm)
None	All of both	42 a	1.0 b	6 a
Removed	All of both	35 ab	1.3 ab	4 a
Removed	All of one	33 ab	1.8 a	4 ab
Removed	Basal ⅔ of both	37 ab	1.5 ab	4 ab
Removed	Basal ⅓ of both	27 b	1.5 ab	3 bc
Removed	None	3 c	0.7 c	1 c
Removed	Mid-section of both	38 a	1.7 a	4 ab

[1] Means within a column followed by the same letter are not significantly different at the 5% level.

after emergence of the new branches. When both cotyledons were removed at the time of stem removal, none of the seedlings resprouted (Table 2). When a third of each cotyledon was left intact branching occurred, but stem elongation and foliar development was retarded. When a single cotyledon, two-thirds of each cotyledon, or the longitudinal, central half of each cotyledon was left intact, growth and development was not significantly different from the untreated seedlings. The cotyledons apparently supplied an energy source for growth of the buds at the cotyledonary node. This regulation was most important during the first three weeks of seedling growth, since plants clipped after normal abscission of the cotyledons sprouted vigorously. The meristematic tissue was evidently regulated by apical dominance of the terminal stem.

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Plaque for A. W. Sampson

The 60th anniversary of the Great Basin Experimental Range will be celebrated in conjunction with SRM's 1972 summer meeting. As part of the planned events, a plaque will be dedicated to Arthur W. Sampson, who was the first director of the Experimental Range. Many of Professor Sampson's range management concepts were developed through his research at this station.

The Utah Section, SRM, is serving as the recipient for funds for the Sampson plaque. Contributions in any amount are solicited and may be sent to *A. T. Fillingim, Secretary-Treasurer, Utah Section, SRM, 850 North 10th East, Price, Utah 84501.*