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Environmental Sciences Division

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EFFECTS OF SEED ORIGIN AND IRRIGATION ON SURVIVAL AND GROWTH OF TRANSPLANTED SHRUBS

V. K. Winkel

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Poster Header

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V. K. Winkel

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ABSTRACT

Revegetation is difficult in the Mojave Desert due to limited, erratic precipitation and extreme temperatures. Establishing plant cover by transplanting native shrubs is known to be a promising technique, but many questions still remain regarding its use on a large operational scale. A study was initiated on the U.S. Department of Energy Nevada Test Site (NTS) to determine the effects of seed origin and irrigation on survival and growth of transplanted shrubs. Plants of three species (*Larrea tridentata*, *Ambrosia dumosa*, and *Atriplex canescens*) were grown in a greenhouse and hardened outdoors. Plants of all three species were produced from two seed sources: 1) seed collected from the NTS (Mojave Desert), and 2) commercially available seed collected from outside the NTS. One-year-old containerized plants (180 of each species) were transplanted to a site on the NTS and irrigated with two liters of water at one of the following frequencies: 1) at time of planting only, 2) at time of planting and monthly during the first growing season, and 3) at time of planting and twice monthly during the first growing season. After 16 months, survival of all species was generally greater than 80% and was unaffected by irrigation treatments. Survival of fourwing saltbush was significantly greater from local versus non-local seed. Survival of bursage and creosotebush was generally unaffected by seed origin. Shrub volumes regardless of species or seed origin increased during the first growing season, and then decreased during the second growing season. Shrub volumes for fourwing saltbush were significantly greater for shrubs from local versus non-local seed.

INTRODUCTION

- Revegetation by seeding is difficult in the Mojave Desert due to limited and erratic precipitation and extreme temperatures.

- Establishing plant cover by transplanting native shrubs appears to be a promising alternative to seeding on the NTS. Romney, Hunter, and others (Great Basin Naturalist Memoirs 1980, Romney et al, 1987) have demonstrated successful plant establishment through the use of transplanted shrubs.

- Species that appear most amenable to transplanting based on survival rates are creosotebush, bursage, and fourwing saltbush.

- Transplanted shrubs may have greater survival if treated with supplemental irrigation. In addition, shrubs grown from seed of local origin may be more adapted than shrubs of the same species grown from nonlocal seed.

OBJECTIVE

The objective of this study is to determine the effects of seed origin and irrigation on survival and mortality of transplanted shrubs.

METHODS

Study Site Description

- The study was conducted in Area 11 of the NTS in southern Nevada, approximately 113 km northwest of Las Vegas (Figure 1).

- The study site is situated on an alluvial fan of the northern slope of French Peak mountain at an elevation of 1271 m (Figure 2). The soil is a gravelly sandy loam. The slope at the site is 3-5 percent and the aspect is northwest.

- The site is in a transition zone between the Mojave and Great Basin deserts with major plant species consisting of shadscale (*Atriplex confertifolia*), winterfat (*Ceratoides lanata*), wolfberry (*Lycium andersonii*), and Indian ricegrass (*Oryzopsis hymenoides*).

- The climate is characterized by hot summers and cool winters. Average annual precipitation for the past 30 years, obtained 5 km from the site, is 168 mm, which falls sporadically throughout the year.

Experimental Design and Treatment Application

- The experimental design was a split, split plot. Irrigation treatments were main plots, species and seed origin were split plots and time was the split, split plot. The species-seed origin-irrigation-time arrangement was a 3x2x3x2 factorial with 3 replications.

- Seed for creosotebush, bursage, and fourwing saltbush was collected on the NTS (local), or obtained from a commercial vendor from sources outside the Mojave Desert (non-local). Plants were grown in a greenhouse and hardened outdoors. One-year-old containerized plants were planted at the study site in March 1993 (Figures 3-5). Ten plants of the same species and seed source were planted 1-m apart in a plot. The field plot layout included fifty-four plots.

- All plants in a plot were irrigated with two liters of water at one of the following frequencies: 1) at time of planting only, 2) at time of planting and monthly during the first growing season, and 3) at time of planting and twice monthly during the first growing season.

Data Collection and Statistical Analysis

- Precipitation, and air temperature were collected on site, and data were recorded with a Campbell Scientific Instruments CR-10 datalogger.

- Plant survival was determined by visual observation in August 1993 and again in July 1994 (4 and 16 months after planting).

- Plant growth was determined by measuring the height, greatest width and width perpendicular to the greatest width of the plant, and then calculating volume (Figure 6). Growth measurements were collected in April and August 1993, and again in July 1994 (two weeks, and 4 and 16 months after planting).

- Analyses of variance were performed on the arcsin square root of percentage data (Sokal and Rohlf 1981) to determine differences in rates of survival, and on untransformed change in volume data to determine differences in rates of plant

growth. Significant differences were identified with Duncans New Multiple Range Test (Lentner and Bishop, 1986).

RESULTS AND DISCUSSION

Shrub Survival

- Analyses of variance of shrub survival data showed significant ($P < 0.04$) 2-factor interactions, involving species, seed origin and time. Interactions involving the irrigation factor were not significant.

- With the exception of fourwing saltbush grown from non-local seed, survival of all species regardless of seed origin exceeded 80% by July 1994 (Figures 7-9). Although varying with seed origin, survival was generally highest from creosotebush, followed by bursage and then fourwing saltbush.

- Although not significant, survival of bursage was greater in 1993 and 1994 from plants produced from local versus non-local seed (Figure 7).

- Survival of fourwing saltbush was significantly ($P < 0.05$) greater from local versus non-local seed during both 1993 and 1994 (Figure 8).

- Survival of creosotebush was slightly greater for plants from non-local seed, although this was not significant (Figure 9).

Shrub Growth

- Analyses of variance of shrub volume data showed highly significant ($P < 0.001$) 2-factor interactions, involving species, seed origin and time. Interactions involving the irrigation factor were not significant.

- Shrub volumes of all species regardless of seed origin increased between April and August 1993. Volumes were greatest from fourwing saltbush, followed by creosotebush and then bursage (Figure 10). Volumes for all species regardless of seed origin decreased between August 1993 and July 1994.

- Shrub volumes for bursage during August 1993 and July 1994 were greater for shrubs from non-local seeds than from shrubs from local seed, although this difference was not significant (Figure 11).

- Shrub volumes for fourwing saltbush were significantly greater ($P < 0.05$) during both August 1993 and July 1994 for shrubs from local versus non-local seed (Figure 12).

- Creosotebush volumes were greatest from non-local versus local seed during August 1993 (Figure 13). This difference was reversed during July 1994. Neither one of these differences was significant.

CONCLUSIONS

- This study has shown that during an initial wet year and with supplemental irrigation, survival of native shrubs was generally greater than 80% and was unaffected by irrigation treatments. Survival of fourwing saltbush shrubs was significantly greater from local versus non-local seed. Survival of bursage and creosotebush shrubs was generally unaffected by origin of seed.

- Shrub volumes regardless of species or seed origin increased during the first growing season, and then decreased during the second growing season. Fourwing saltbush and creosotebush shrub volumes from non-local seed decreased to below baseline volumes by July 1994. The 1994 growing season was much dryer than the 1993 season. This may help to explain the decreases in shrub volumes from August 1993 to July 1994. In addition, some herbivory by rabbits and insects occurred during the 1994 growing season.

- Future monitoring will determine whether shrub survival and volume trends continue.

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Figures

Figure 11. Changes in volume of bursage transplants in relation to seed origin and time. Means for seed origin treatments within a year with the same letter are not significantly different ($P > 0.05$).

Figure 12. Changes in volume of fourwing saltbush transplants in relation to seed origin and time. Means for seed origin treatments within a year with the same letter are not significantly different ($P > 0.05$).

Figure 13. Changes in volume of creosotebush transplants in relation to seed origin and time. Means for seed origin treatments within a year with the same letter are not significantly different ($P > 0.05$).

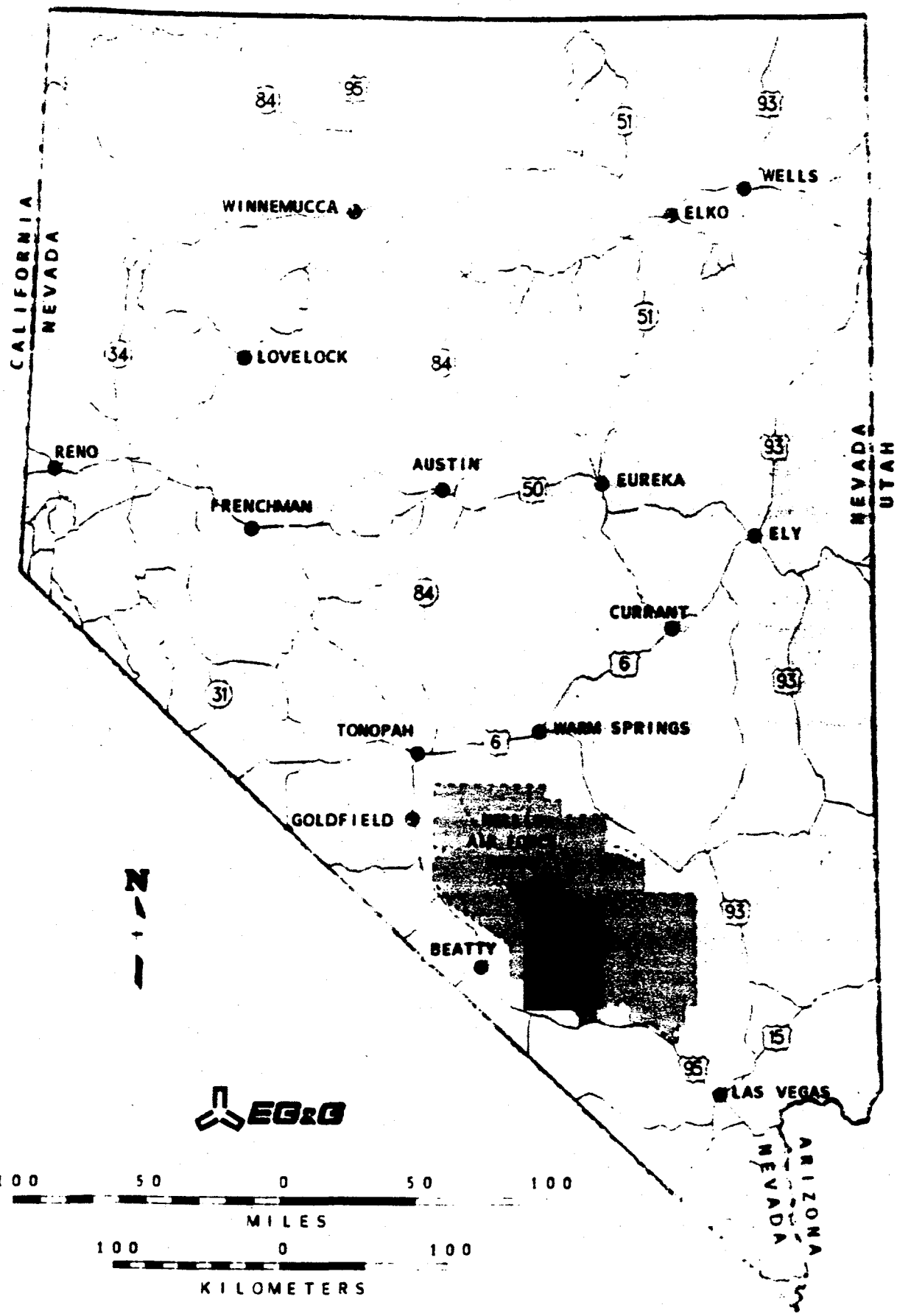
CALIFORNIA
NEVADA
NEVADA
UTAH
NEVADA
ARIZONA
WINNEMUCCA
WELLS
ELKO
LOVELOCK
RENO
AUSTIN
EUREKA
FRENCHMAN
ELY
CURRANT
TONOPAH
WARM SPRINGS
GOLDFIELD
BEATTY
LAS VEGAS
84
95
51
93
34
50
6
31
15
N
EG&G
100 50 0 50 100
MILES
100 0 100
KILOMETERS

Fig. 1

Fig. 3

Fig. 4

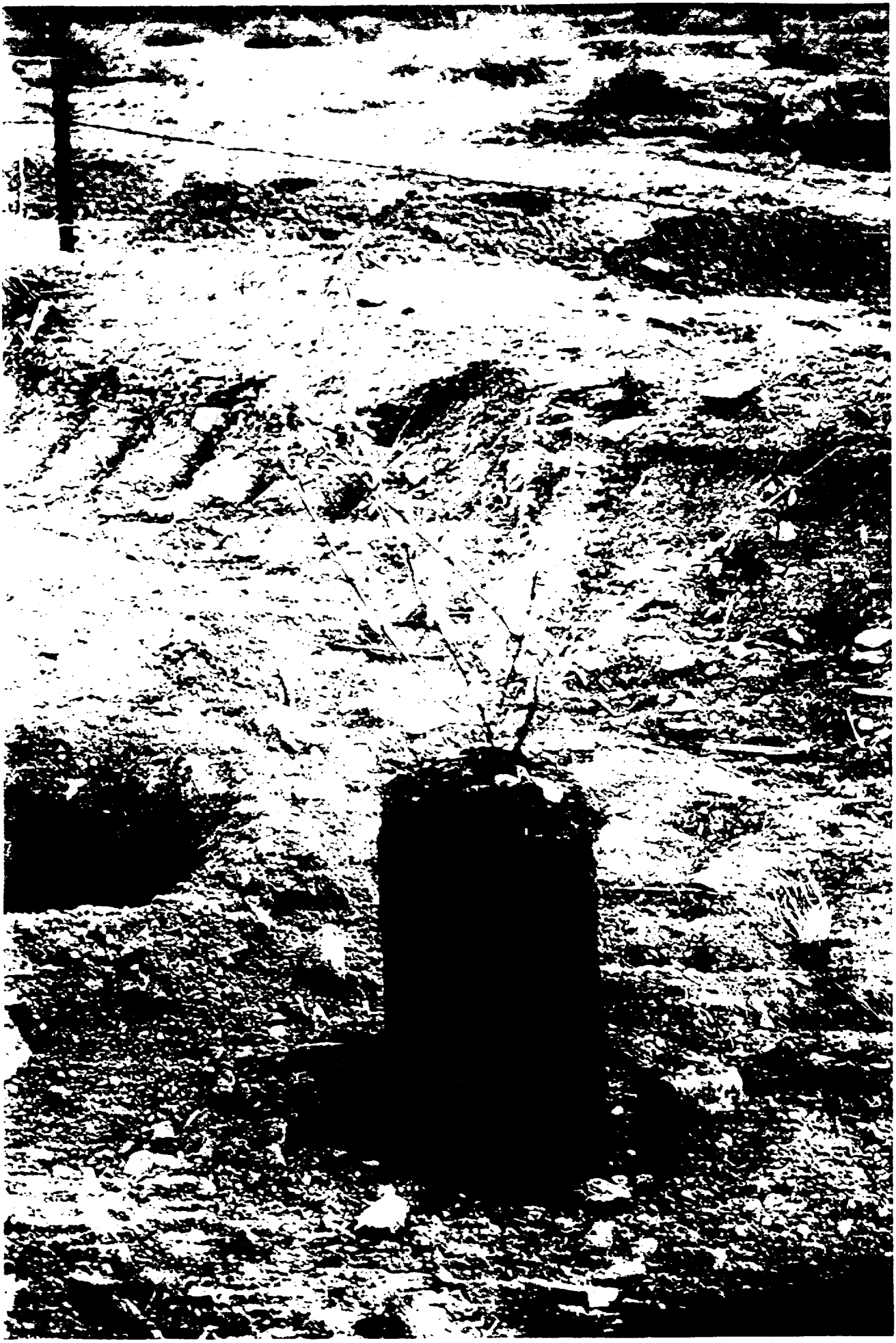

Fig. 5

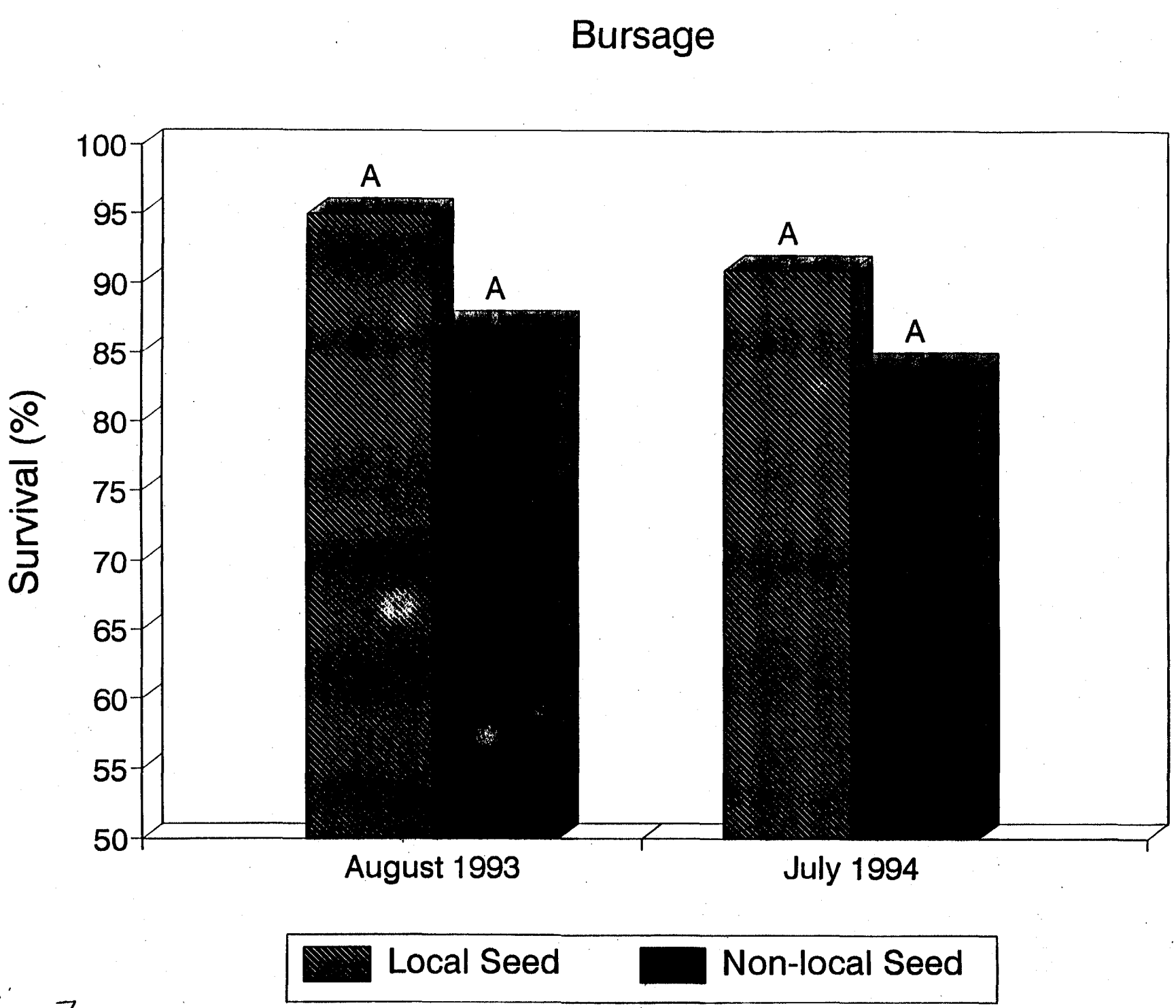
Bursage
Survival (%)
100
95
90
85
80
75
70
65
60
55
50
A
A
A
A
August 1993
July 1994
Local Seed
Non-local Seed

Fig 7

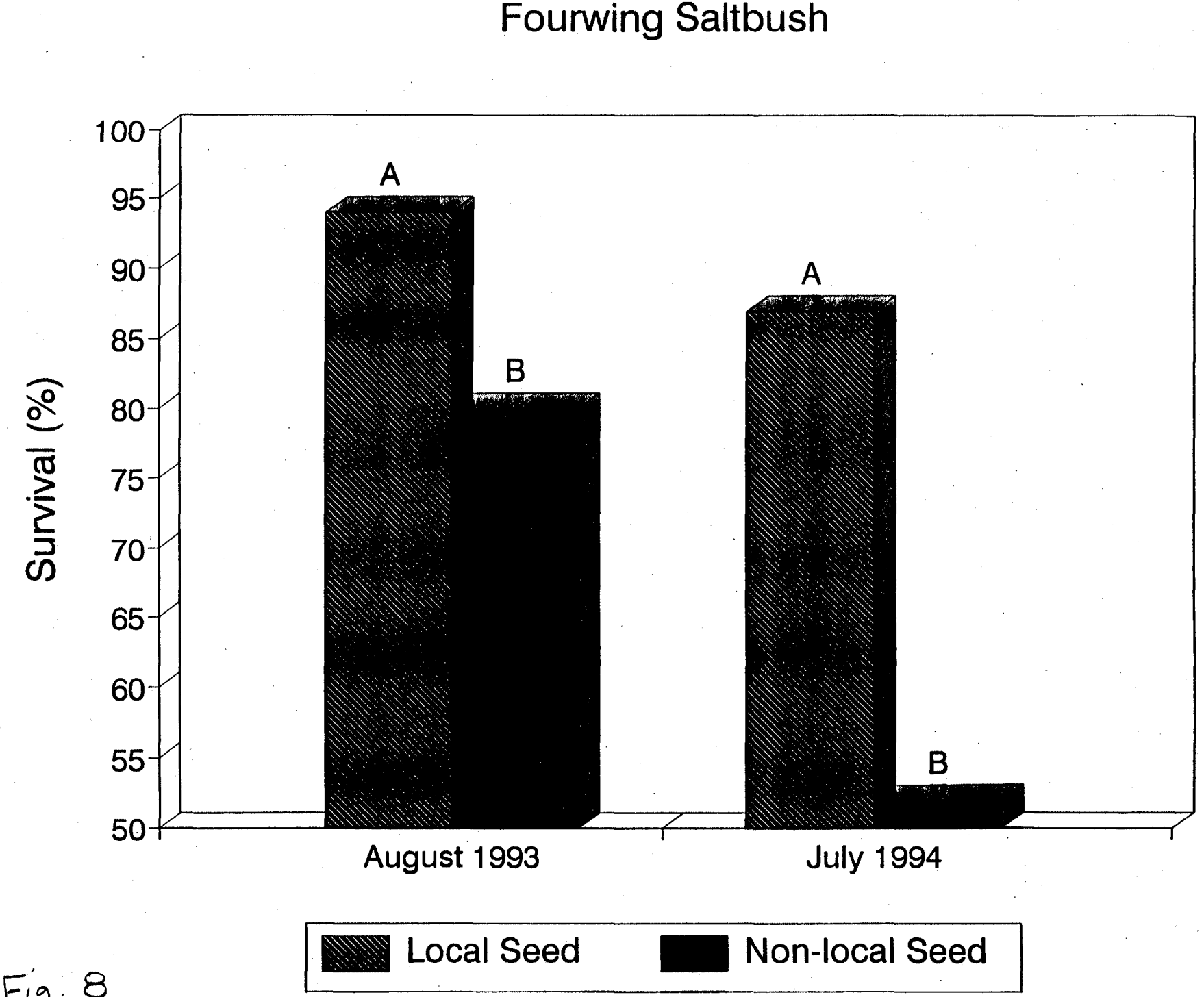
Fourwing Saltbush
Survival (%)
100
95
90
85
80
75
70
65
60
55
50
A
B
A
B
August 1993
July 1994
Local Seed
Non-local Seed

Fig. 8

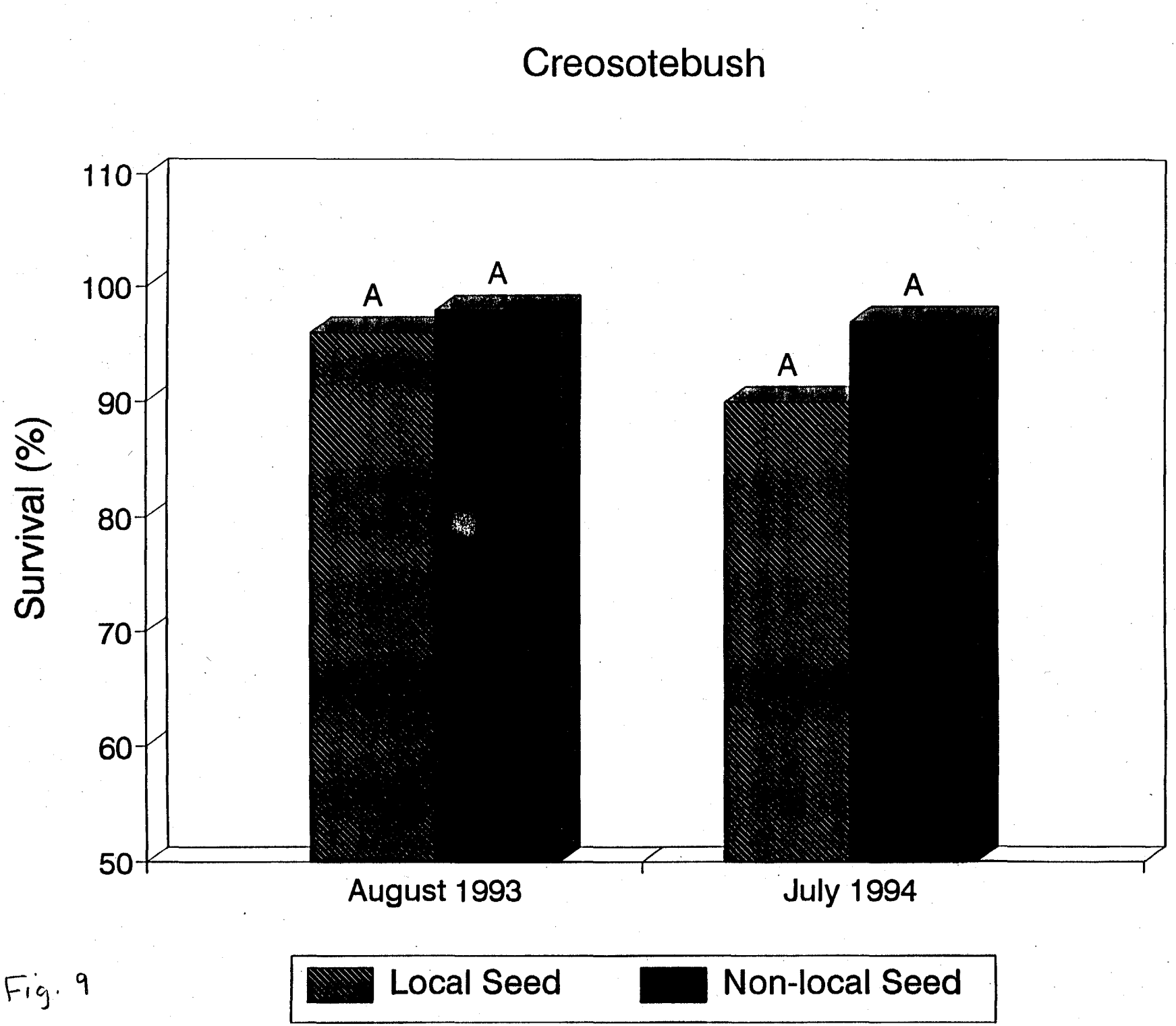
Creosotebush
110
100
90
80
70
60
50
Survival (%)
A
A
A
A
August 1993
July 1994
Local Seed
Non-local Seed

Fig. 9

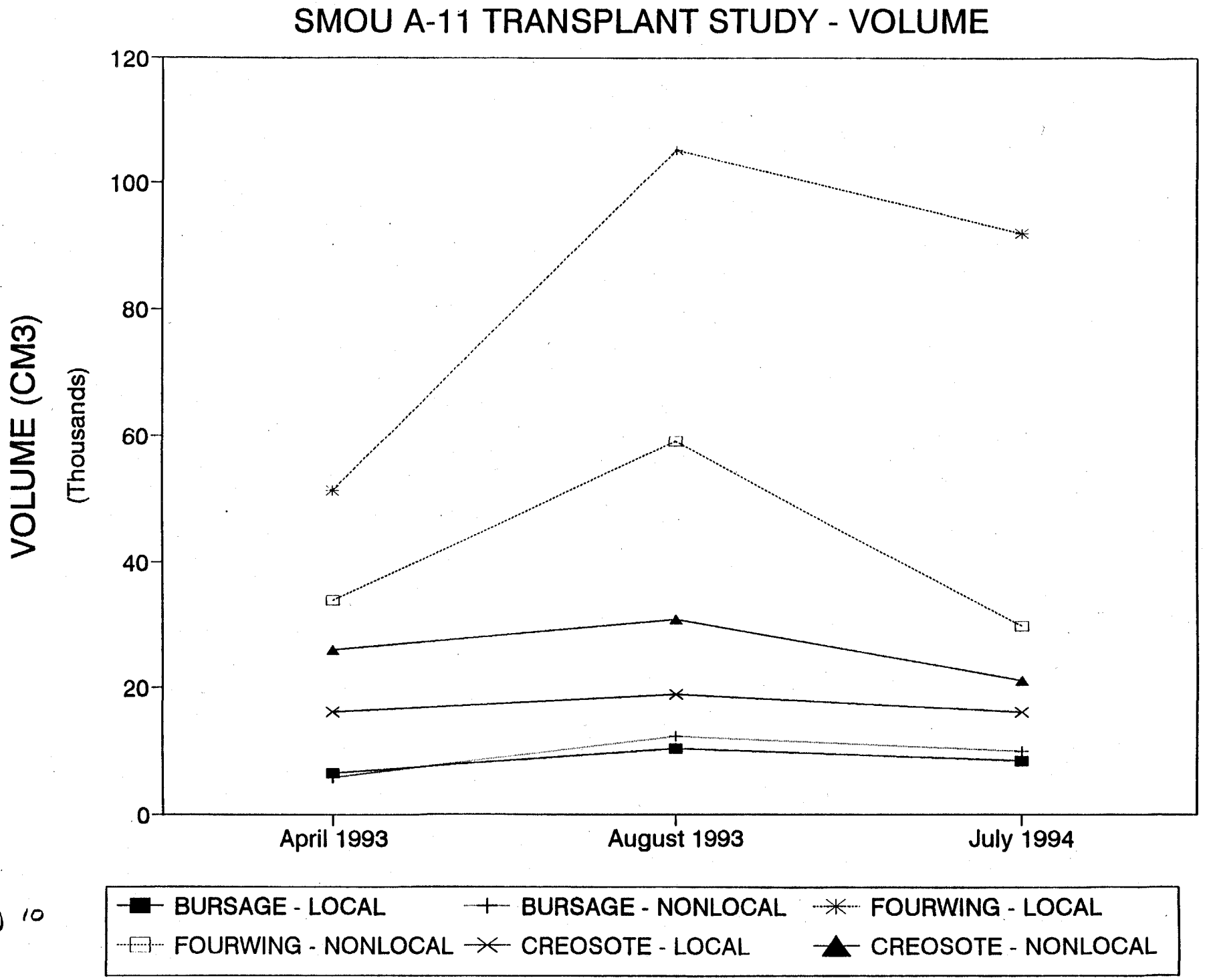
SMOU A-11 TRANSPLANT STUDY - VOLUME
VOLUME (CM3)
(Thousands)
120
100
80
60
40
20
0
April 1993
August 1993
July 1994
BURSAGE - LOCAL
BURSAGE - NONLOCAL
FOURWING - LOCAL
FOURWING - NONLOCAL
CREOSOTE - LOCAL
CREOSOTE - NONLOCAL

Fig 10

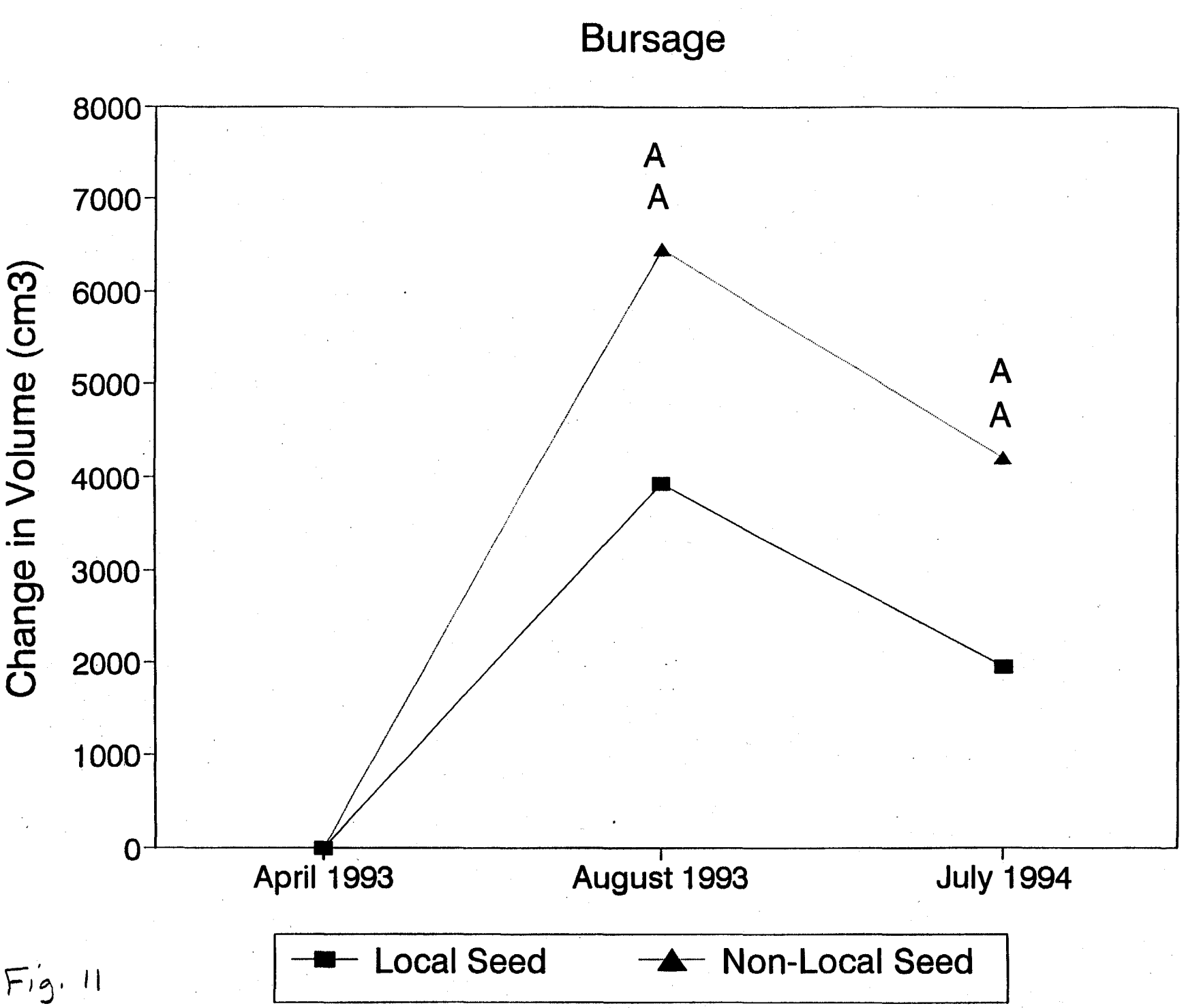
Bursage
Change in Volume (cm3)
8000
7000
6000
5000
4000
3000
2000
1000
0
A
A
A
A
April 1993
August 1993
July 1994
Local Seed
Non-Local Seed

Fig. 11

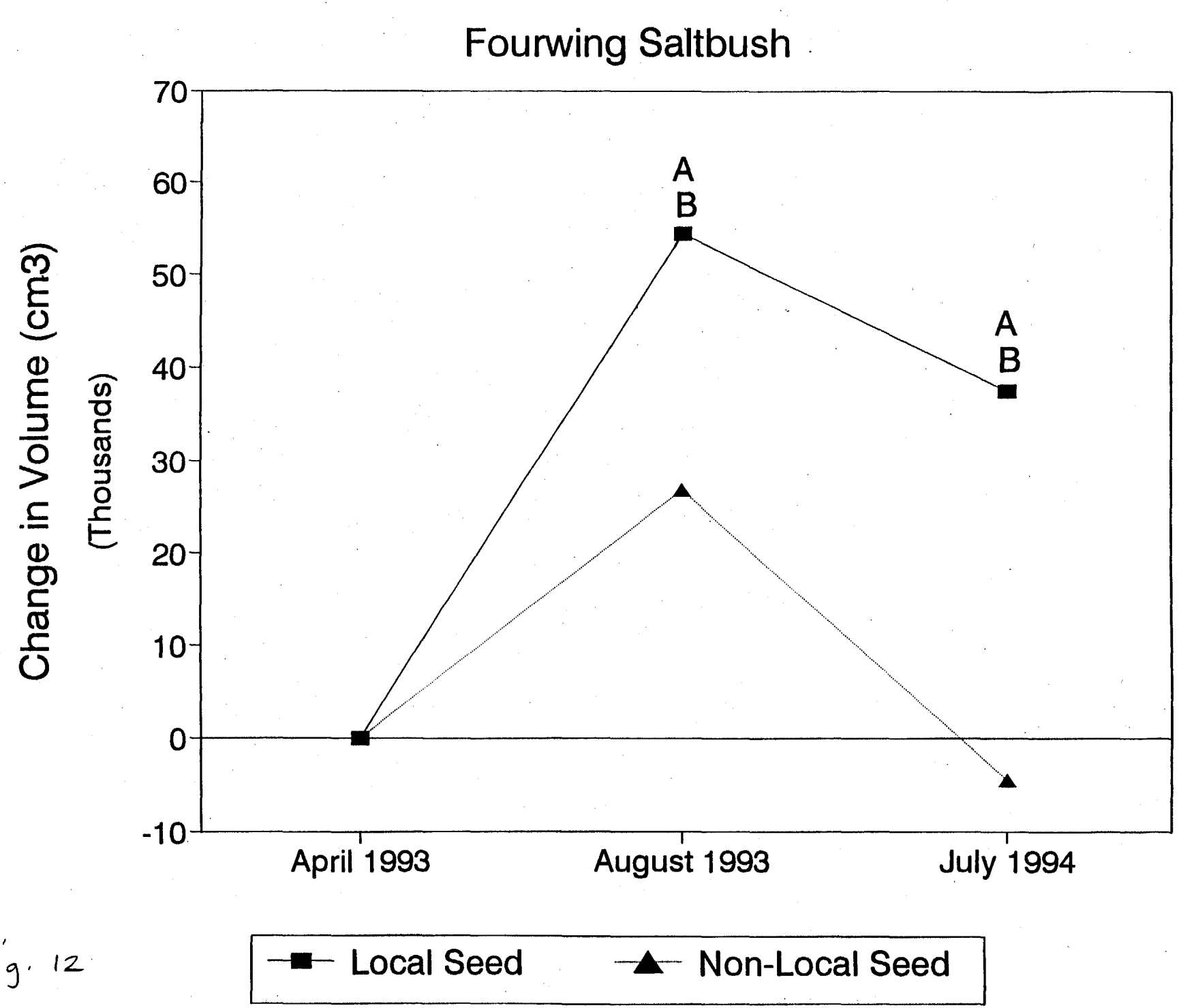
Fourwing Saltbush
Change in Volume (cm3)
(Thousands)
70
60
50
40
30
20
10
0
-10
A
B
A
B
April 1993
August 1993
July 1994
Local Seed
Non-Local Seed

Fig. 12

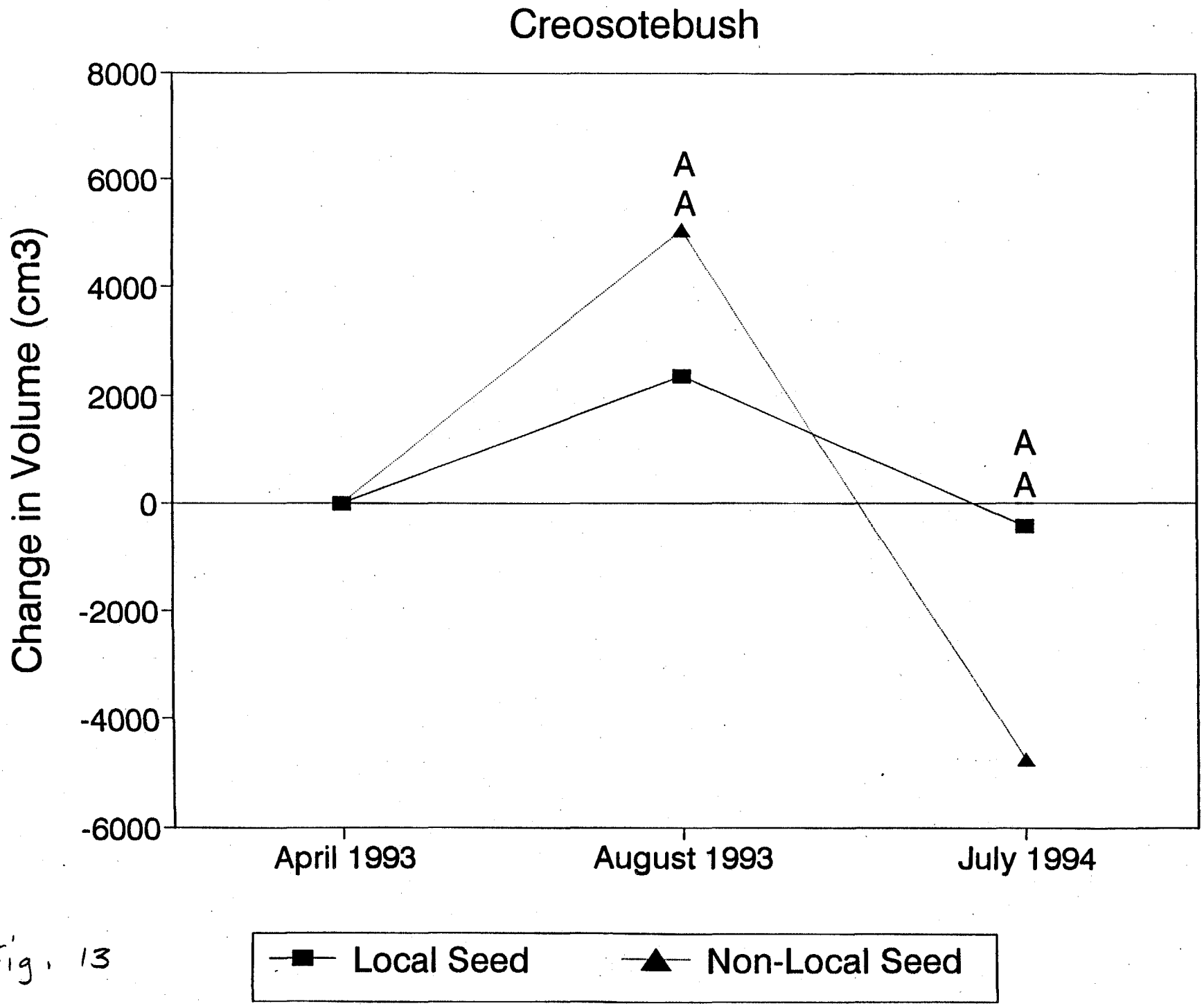
Creosotebush
8000
6000
4000
2000
0
-2000
-4000
-6000
Change in Volume (cm3)
A
A
A
A
April 1993
August 1993
July 1994
Local Seed
Non-Local Seed

Fig. 13