

# Nitrogen-Fixation by Deerbrush

greenhouse experiments suggest deerbrush has root nodules like leguminous plants with nitrogen-fixing properties

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**Recent studies** indicate that nodules on the roots of deerbrush—*Ceanothus integerrimus*—supply this species with a source of nitrogen and might greatly improve growth of the plant, especially in soils where nitrogen is a limiting factor.

In a greenhouse experiment with forest soil designed to test the fertilizer effects of nitrogen, phosphorus, potash, and sulfur on deerbrush, it was found that the plant responded only to nitrogen. In the second season it was noted that some of the plants in the pots where nitrogen had not been supplied were as tall as those in the pots which had been fertilized with nitrogen, but other plants in the same pots remained small. The roots were carefully removed from the soil. The large plants were found to have big nodules; the small ones had very small nodules or none at all. Since this test showed that originally only nitrogen was restricting the growth of these plants, as shown in the table, the presence of

**Deerbrush Plants with Root Nodules**  
 Dry weights of shoots of deerbrush grown in soil fertilized with combinations of nitrogen (N), phosphorus (P), potassium (K), and sulfur (S). Five plants were grown in 10" pots filled with Holland sandy loam and treatments set up in triplicate. Four plants were nodulated in the check and one in the PKS or minus nitrogen treatment.

Treatment	Dry weight of shoots per plant (grams)			Ave.
	1	2	3	
<b>Check</b>				
Plants without nodules ...	0.7	0.7	0.4	0.60
Plants with nodules ... none		5.7	5.0	5.35
<b>NPKS</b> .....	9.8	12.0	11.0	10.93
<b>PKS</b>				
Plants without nodules ...	0.6	0.6	0.7	0.63
Plants with nodules ...	5.1	none	none	5.10
<b>NKS</b> .....	8.8	8.2	9.6	8.87
<b>NP</b> .....	9.8	9.6	10.2	9.87

the nodules would strongly suggest that they were functioning to supply the plants with nitrogen.

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These two plants came from the right-hand pot in the illustration on the left. It is thought that the large nodule fixed nitrogen for the plant.

**One deerbrush plant in this fertilizer treatment greatly outgrew the others. No nitrogen was added.**



San Diego counties offered only limited service. By comparison, fewer than one half of the stores in Butte and Fresno counties limited their delivery.

Urban stores offered delivery service relatively more frequently—26%–46%—than rural stores—0%–33%—in all of the counties. In Butte and Fresno counties, 26%–46% of the urban stores as compared with 10%–25% of the rural stores provided delivery. Of the stores

**Delivery Service Offered by Surveyed Grocery Stores**

County	Surveyed stores with delivery service	Type of delivery service	
		Full	Limited
Butte .....	21.1%	52.2%	47.8%
Fresno .....	39.5	56.7	43.3
San Diego ....	40.6	44.4	55.6
Alameda .....	44.2	42.4	57.6
Los Angeles ...	28.6	41.7	58.3

offering the service, the tendency was for the rural stores to limit delivery relatively more frequently—45%–100%—than the urban stores—40%–58%.

For the most part, stores in downtown shopping areas provided delivery service relatively more frequently than isolated stores or stores in neighborhood-secondary shopping areas. For downtown stores the proportions offering delivery varied from 32% in Los Angeles County to 65% in Fresno County. For neighborhood-secondary stores, from 28% of the stores in Butte and Los Angeles counties to 45% in San Diego County offered the service. Among the isolated stores the proportions providing delivery ranged from 3% in Butte County to 41% in Los Angeles County.

Of the stores making some type of delivery service available, one half or more of the downtown stores in four counties—50%–100%—did not restrict

its use. The exception was in Alameda County where only 30% of the stores provided full delivery service.

On the other hand, over one half of the neighborhood-secondary stores in each county—51%–62%—offered only limited delivery service. In each of four counties, over seven tenths of the isolated stores—71%–100%—also offered only limited service. The exception was in Fresno County where 30% of the isolated stores offered the limited type of delivery service.

Delivery service was provided primarily by independent stores. The proportions of independent stores offering this service varied from 23% in Butte County to 53% in Alameda County.

As in the case of telephone service, a larger proportion of affiliated independent stores in each county than of nonaffiliated stores provided delivery. From 33% to 64% of the affiliated stores as compared with 17%–48% of the nonaffiliated stores offered such service. Alameda County had the highest proportions of both groups of independent stores offering delivery service and Butte County the lowest.

Only a small proportion of the chain stores in each county, one eighth or fewer, offered delivery service. In three counties, Alameda, Butte, and Los Angeles, the proportion of chain stores that provided delivery—3%–7%—was the same as the proportion that provided telephone service. In San Diego County delivery was provided by 12% of the stores but telephone service by only 4%. Although one fifth of the chain stores in Fresno County offered telephone service, none of them offered delivery service.

Considerable variation from county to county existed in the extent to which independent stores with delivery provided full or limited service. In Butte and

Fresno counties the majority of stores—55%–57%—had not restricted the availability of this service. On the other hand, in Alameda, Los Angeles, and San Diego counties the majority of stores—57%–58%—provided only limited delivery.

Of the independent stores offering delivery service, 43%–72% of the affiliated stores as compared with 33%–58% of the nonaffiliated provided limited service.

None of the chain stores offering delivery service in Alameda and San Diego counties placed any restrictions on its availability. By comparison, 83% of the chain stores in Los Angeles County and all chain stores in Butte County placed some restrictions on delivery.

As in the case of telephone service, stores employing 3–6 persons, for the most part, offered delivery service relatively more frequently than stores with either larger or smaller numbers of employees. From 32% to 82% of the stores with 3–6 employees made such service available as compared with 16%–42% of the stores with one or two persons and 6%–67% of those stores with 7–14 employees. Relatively few—0%–20%—of the stores employing 15 or more persons offered delivery service.

Of the stores supplying delivery service, the tendency was for relatively more of those employing one or two persons—41%–73%—and of those employing 15 or more persons—50%–100%—to offer only limited service. Conversely, the majority of those stores with 7–14 employees—50%–100%—offered full service. The proportions of stores employing 3–6 persons that provided limited and full delivery service were about equal.

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## DEERBRUSH

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Further studies are being made on deerbrush and other species of this genus to learn more about the relationship between nodules and nitrogen-fixation. There are about 40 species in this genus and at least one occurs in practically every plant association in California.

Deerbrush is abundant on many forest areas in California, especially in the ponderosa pine zone where the soil nitrogen is generally low. Deerbrush is also one of the more important browse species, being well liked by deer, cattle, and sheep.

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*The above reported studies are a part of a project conducted cooperatively by the University of California and the California Department of Fish and Game under Federal Aid in Wildlife Restoration Act Project 51-R.*

## APPLE APHID

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taking 25 curled leaves at random from each plot and counting the live and dead aphids.

The systemic insecticides, Systox and Thimet, and the nonsystemic phosphate, Diazinon, all gave good control of the aphids, and new growth remained free of infestation for the rest of the season. Guthion, Nialate, and Thiodan all gave a measure of control, but it was not suf-

ficient to prevent continued infestation of the foliage. By three weeks after application, the new growth on these plots was again heavily infested, and it was not possible to tell that a treatment had been applied.

These data, however, do show that it is possible to obtain control of the rosy apple aphid with a foliage treatment. The controls directed against the overwintering eggs are preferred, however, because it is easier and less costly to apply control materials during the delayed dormant period.

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*The above progress report is based on Research Project No. 806.*