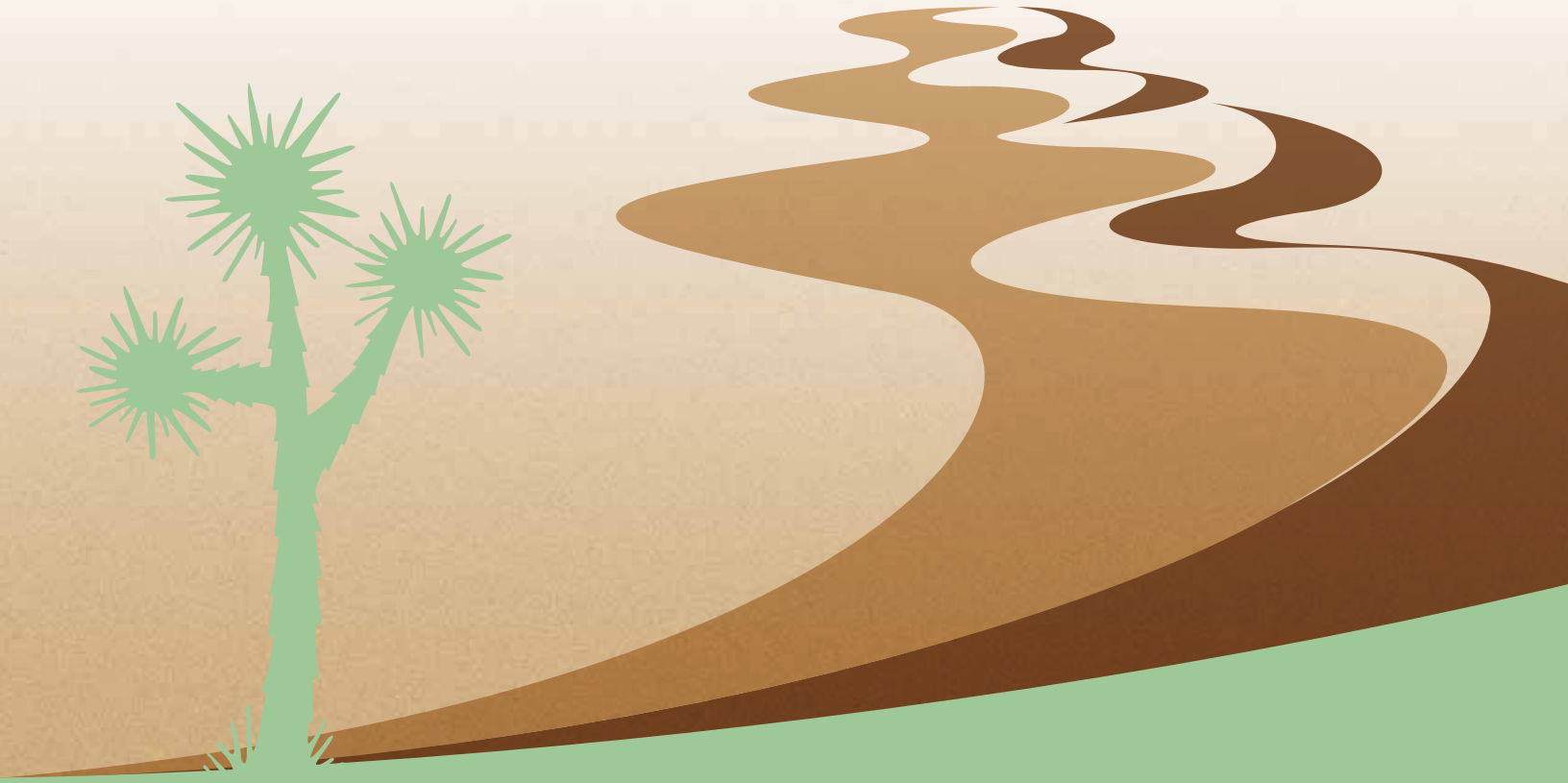
Agricultural Guide

to Controlling Windblown Sand and Dust



Information in this manual applies to high elevation desert regions of Southern California. It is based on approximately 20 years of research conducted by the Dustbusters Research Group in the Antelope Valley of Northern Los Angeles County.

ANTELOPE VALLEY DUSTBUSTERS

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Front Cover: Blowing dust in the Antelope Valley has led to reduced visibility and serious traffic accidents. A number of techniques suppress blowing dust, even in very sandy areas.

Back Cover: The undisturbed or revegetated desert displays a mix of plant species and prevents blowing dust.

Dustbusters Research Group

In 1991, the Dustbusters Research Group formed a task force to develop best management practices for mitigating wind erosion, reducing blowing dust, and improving air quality in the Antelope Valley. Since then, Dustbusters has developed and implemented a land treatment program to minimize wind erosion through vegetative and mechanical procedures.

The Dustbusters Research Group consists of private entities as well as federal, city and county government representatives. These include the USDA Natural Resources Conservation Service, Southern California Edison, Antelope Valley Air Quality Management District, City of Los Angeles Department of World Airports, University of California Cooperative Extension, San Diego State University, Midwest Research Institute, Los Angeles County Fire Department – Forestry Division, Antelope Valley Resource Conservation District, and local farmers from Bolthouse Farms, Calandri Farms, Giba Farms, Kindig Farms, Nebeker Ranch, and Munz Ranch.

Summary

Growers in the high elevation Mojave Desert and other Southwestern U.S. locations encounter extended droughts, high winds, soil erosion, and other circumstances that result in blowing dust. Agricultural soils may be exposed briefly between crops, or as fields are fallowed for 1 to 3 years, grazed by sheep, or taken completely out of production. Any process that reduces vegetation cover also invites dust problems. Wind speeds in this area can exceed 50 mph. When the wind blows, dust from unprotected areas will follow.

Many public and private agencies are available to help growers manage their dust problems. In some cases, financial assistance is available. The techniques in this Guide may serve as a starting point. However, a comprehensive erosion management program may require consultation with experts.

Information in this Guide will assist growers with control of blowing sand and dust. It is based on almost 20 years of research conducted in Antelope Valley by the Dustbusters. It also provides information on cost sharing with federal agencies. Two other Guides have been prepared, for homeowners, and for large area land managers. (Website reference--cross reference Homeowners Guide and Large Area Land Managers Guide (URLs here)

Growers in the Antelope Valley can contact one or more of the resources listed in the Resources Guide. Growers in other areas may also benefit from these resources or by contacting similar agencies in their own production areas.

Figure 1: The undisturbed desert is stable and is not a source of blowing dust.

Overview of the Problem

History

Many growers in the Antelope Valley remember the prolonged drought from 1985 to 1992 and the high winds up to 50 mph that propelled giant dust clouds across the Valley. Poor air quality intensified respiratory health problems, reduced visibility and triggered major highway accidents. Deep deposits of blown sand negatively impacted crop production and property values. (See Figures 2 and 3.)

Figure 2: Land clearing for agricultural or other purposes can initiate a self-perpetuating cycle of disturbance.

Desert soils are typically crusted and protected from wind by scattered native vegetation. Soils are also protected by crops. Agricultural production in the Antelope Valley generally consists of rotations among forage crops (alfalfa, grains, hay), onions, carrots, and potatoes. Even areas of loose sand are protected if vegetation coverage is sufficient.

Figure 3: Blowing sand can bury crops or sandblast them.

Vehicle traffic, construction activities, and agricultural production can damage or destroy vegetation, disrupt crusts, and lead to wind erosion. In agricultural production systems, some ground remains fallow for more than 1 year to reduce soil-borne pathogens or for economic reasons.

Why Dust Blows

For growers, blowing dust comes from two sources, land you own or lease and the land upwind of it. Sand blowing from upwind may cause your previously stable ground to begin to erode, as high winds pick up loose sand particles and bounce them along the ground. This saltation of sand and other coarse particles sandblasts the soil surface, eroding the stable crust, dislodging additional particles, and causing further erosion. Saltating particles can kill vegetation, scour stable land, and cause dust to be lofted into the air. (See Figure 4.) Wind rarely lifts sand higher than about 3 feet above ground. However, fine dust rises much higher, which eliminates any practical means of capture.

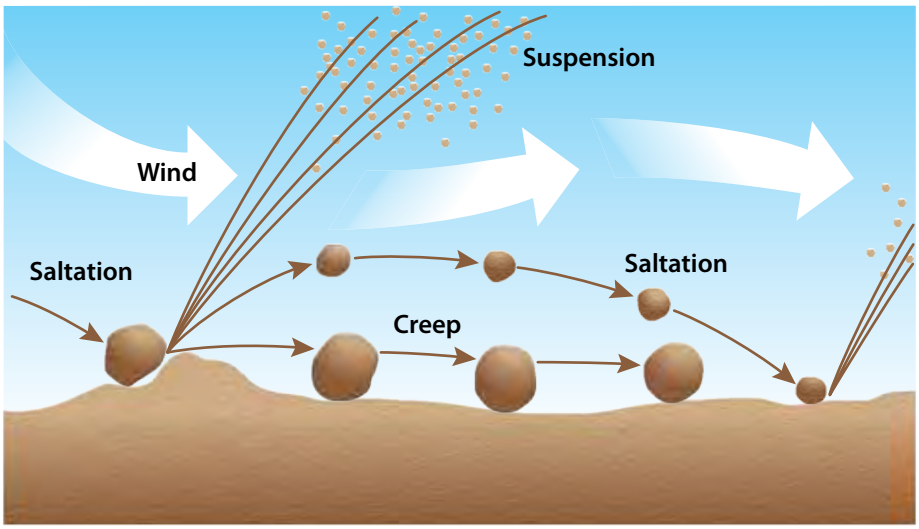

Figure 4: Wind erosion begins with particle creep (rolling) of large particles. Soon, saltation (bouncing) of sand particles begins. These energetic particles erode even stable soil, causing suspension of dust particles into the air.

As a grower, you may choose to implement procedures that control dust, in order to improve visibility, reduce wind erosion and loss of topsoil, minimize damage to roads and structures, and limit health impacts due to poor air quality. Effective dust control methods conserve your topsoil, protect your downwind cropped acreage, and support compliance with air quality regulations. Soils remain viable for production only when soil loss is held below about 5 tons per acre per year. Dust regulations require submittal of a Best Management Practice Plan that includes selection of Practices for Agricultural Operations specifically developed for control of fugitive dust in the Mojave Desert.

Effective Dust Control Measures

Growers typically encounter dust problems with farmland, farm roads, equipment yards, and deep sand.

A number of dust control measures address these problems and have been evaluated in the Antelope Valley.

To establish an effective dust control program, determine:

- How long protection needs to last
- Which crop will follow the protected period
- How much irrigation water will be available.

Figure 5: Irrigation may be the key to establishing vegetation for dust control.

Table 1 on the next page, lists these measures and their associated USDA/NRCS Conservation Practice Codes.

Cost-Sharing Programs

Growers may be able to receive financial assistance for dust control.

The local NRCS EQIP Program may be able to provide cost share funds to implement the Conservation Practices listed in Table 1. For Practice requirements, job sheets, and other information, contact Antelope Valley USDA/NRCS office at 661-945-2604.

The Conservation Reserve Program (CRP) is another cost share program. It encourages growers to voluntarily plant permanent areas of grass and trees on land that needs protection from erosion. This vegetative cover also serves as a windbreak. Additional information is available from the local USDA Farm Service Agency at 661-942-9549.

Table 1: Dust control practices to consider in the Antelope Valley and their associated USDA/NRCS Conservation Practice and Reference Code.

Situation	Suggested Practices	Conservation Practice	USDA/NRCS Reference Code*
Farmland – high or low elevation	Cover crops – high or low value	Cover Crop	340
	Strip crops	Strip Cropping - Contact your local NRCS for guidance	585
		Cross Wind Trap Strips	489C
		Residue and Tillage Management - No Till / Strip Till / Direct Seed	329
	Mulch	Residue and Tillage Management - Mulch Till	345
	Native vegetation – buckwheat (only above valley floor)	Conservation Cover	327
	Roughened surface or furrows across the wind	Surface Roughening or Emergency Tillage	609
	Wind breaks and wind barriers	Windbreak / Shelterbelt Establishment	380
		Herbaceous Wind Barriers	603
	Mulch – wood chips or gravel	Mulching	484
Deep sand	Rice grass	Range Planting	550
	Wind breaks	Windbreak / Shelterbelt Establishment	380
	Mulch – wood chips or gravel	Mulching	484
Farm roads and equipment yards	Chemical coatings	Dust Control on Unpaved Roads and Surfaces	729
	Gravel		
	Paving		

NOTE: This list identifies the most common (but not all) Conservation Practices for growers. For information about additional options or for assistance, growers can contact the Antelope Valley U. S. Department of Agriculture Natural Resources Conservation Service (USDA/NRCS) office at 661-945-2604. Additional resources are listed in the Resources Guide.

* For more detailed information about these Conservation Practices, go to the USDA/NRCS website *http://www.ca.nrcs.usda.gov/*. Under Quick Access in left margin, select Electronic Field Office Technical Guide (eFOTG). Then click on California Map to select county. Page opens to display list of eFOTG sections in left margin. Select Section IV; then select Table of Contents. As an option, select Conservation Practices under the individual folders that appear under the Table of Contents heading.

Cover Crops in Field and Vegetable Systems

Cover crops include grasses, legumes, and forbs for seasonal cover and other conservation purposes. (See Figure 6.) They effectively reduce erosion from wind. They can be used on all arable lands and even on very sandy ground with appropriate techniques.

Figure 6: Even in sandy areas, it may be possible to install a cover crop such as barley, particularly with favorable rains or irrigation. Planting across the wind provides considerable suppression of blowing sand.

Use cover crops when large acreage is leased and/or will be farmed in the near future. Cover crops add organic matter and nutrients to soil and may break disease cycles. Yields of subsequent crops may be significantly improved. Selection of a cover crop requires a cost-benefit analysis. Growers may select a cover crop based strictly on economic analysis or because it fits into their rotation in terms of equipment, planting dates, markets, or potential for hosting pests.

High value cover crops such as cowpea and *Sesbania* perform well in the Antelope Valley. They are relatively expensive to establish, but they improve soil quality and may provide a sizeable economic return. Consider using high value covers if fallow period is only a few months and particularly if it is followed by high value vegetables.

Lower value cover crops such as cool season grains and warm season Sudangrass also perform well in this area. They are less expensive to establish and provide less benefit to soil than higher value options. However, they better resist degradation and therefore can stabilize land for up to 3 years.

Residue breakdown is critically important in cover crop selection. When vegetables follow a fallow period, avoid cover crops with high C:N ratios, such as cereals or Sudangrass. These crops slow residue breakdown and immobilize nutrients.

Mustard is a suitable cover crop for short term fallow farm land. It produces a low C:N ratio and breaks down quickly in the soil, releasing high levels of nitrogen. Mustard appears to enhance soil structure and increases yields of following crops such as carrots.

There is the potential for mustard residue to be a Pythium population host, but mustard appears to have a neutral effect on carrot cavity spot. Subsequent carrot plantings should be delayed 1-3 months to allow for residue decomposition. Cover crops with similar properties are *Sesbania* and cowpeas.

The following table suggests cover crops for the Antelope Valley.

Table 2: Suggested cover crops for the Antelope Valley.

Category	Type	Persistance	Crop Characteristics
Low cost	Cool season cereal grains	< 3 years	**Cereal Grains** – Easy to establish; marketable as forage. Without winter moisture, may need approximately 8 inches of irrigation to achieve adequate cover. Full irrigation (18 inches) increases costs by nearly 8 times (based on 2002 data). When planted in fall, may germinate on winter moisture. For information about current variety choices, contact the Antelope Valley Office of either the U. S. Department of Agriculture Natural Resources Conservation Service (USDA/ NRCS) or the University of California – Los Angeles County Cooperative Extension. (See the Resources Guide for contact information.)
Moderate cost	Cool season mustard	<3 months	**Mustard** – Short growing season; breaks down quickly in soil (<3 months). Suppresses soil-borne nematodes, diseases, and in some cases weeds. Returns applied N to soil. Does not fix N. Not a reliable substitute for Vapam fumigation.
High cost-high value	Cool season legume, vetch	<3 months	**Vetch** – Cool season legume; residue breaks down quickly (< 3 months). Adds N by fixation. Plant October – February.
Moderate cost	Warm season Sudangrass	< 3 years	**Sudangrass** – Warm season forage plant after April. After harvest, stubble residue will hold soil and prevent it from blowing. For a grain crop during growing season, plant Sudangrass from May – August. Requires supplemental irrigation. Can be chopped in summer and stubble will stabilize soil for remainder of season or subsequent seasons.
High cost-high value	Warm season legumes	< 3 months 3-6 months for *Sesbania*	**Legumes** (cowpeas, other beans, and *Sesbania*) – High value and high seed cost; break down in soil quickly. Add N by fixation. Plant before August for maximum benefits.
High cost-high value	Perennial native shrubs	> 3 years	**Saltbush** *(Atriplex spp.)*; **Buckwheat** *(Eriogonum)*; **Rabbit brush** *(Chrysothamnus nauseosus)*; **Indian rice grass** *(Oryzopsis hymenoides)* – May require starter irrigation and are inhibited by excess soil nitrogen. Will hold soil indefinitely once established.

Stripcropping

Stripcropping consists of growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips across the wind. (See Figure 7.) The practice can reduce costs and soil erosion and can protect growing crops from damage by wind-borne soil particles.

Figure 7: Strip cropping reduces expense while providing nearly all the benefit of a full cover crop.

The erosion-resistant (planted) and erosion-susceptible (unplanted) strips should be equal width, in multiples of the width of planting equipment, so that at least 50% of the ground is erosion resistant. No adjacent strips should be erosion-susceptible at the same time. When the strip orientation is not perpendicular to the wind, adjust the width, with the effective width measured along prevailing wind erosion direction and the minimum width determined by the width of unplanted strip.

Residue and Tillage Management – No Till / Strip Till / Mulch Till/ Direct Seed

These variations on cover crop practices consist of managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year round. The emphasis is on minimizing soil-disturbing activities to only those necessary to place nutrients, condition residue, and plant crops. All or part of the field may be cultivated, as appropriate.

The following table provides recommend planting dates, seed rates, and depths for cover crops and native species in the Antelope Valley.

Table 3: Recommended planting dates, seed rates, and depths for cover crops and native species in the Antelope Valley.

Crop	Planting Date	Seed Rate (lbs/acre)	Seed Depth
Cowpeas	May 1 - July 30	30 lbs	0.25-0.50 inches
Sesbania	May 1 - July 30	8 lbs	0.25 inches
Sudangrass	May 1 - July 30	50 lbs	1 inch
Native species	October - February	Dependent upon species. Consult seed company	Broadcast / drill 0.50 inches
Cereal grains	October - February	50 lbs	2 - 4 inches

Table A2 in the Appendix provides recommended planting procedures for selected cover crops in the Antelope Valley. Review this table prior to planting.

Access roads may allow erosion and their width must be considered in laying out the resistant strips. To keep the system functional as long as possible, remove or smooth sediment that accumulates along the strip edges.

Cover Crops in Perennial Tree and Vine Systems

In orchards and vineyards, consider using cover crops as a dust control method. (See Figure 8.) Many orchards and vineyards are drip irrigated and are not set up for irrigation between crop rows. Thus, common cover crops for vineyards are annual grains or drought tolerant grasses. Plant these in fall or winter for germination on winter moisture. They do not require supplemental irrigation. When selecting a cover crop in perennial trees and vines, evaluate problems associated with insect control. Cover crops can host pests such as spider mites and leaf hoppers, as well as beneficial insects.

Figure 8: Prevent erosion between rows of permanent crops with a cover crop. The cover may be chosen to provide nitrogen or other horticultural benefits.

Long Term Native Plant Cover

Consider using native species for periods longer than 3 years. These species provide the greatest sustainability and return the system as closely as possible to its natural state, which typically resists erosion.

For farmland that will be fallow for longer than 3 years, choose native grasses and shrubs. Dustbusters experiments evaluated saltbush *(Atriplex spp.)*, California buckwheat *(Eriogonum fasciculatum)*, rabbit brush *(Chrysothamnus nauseosus)*, and Indian ricegrass *(Achnatherum hymenoides)*. These species establish adequate long term ground cover under specific conditions in the Antelope Valley. In some cases, seed costs of native plants are high and seed availability is low. Obtain specific seeding rates and methods from the Antelope Valley USDA/NRCS.

Broadcasting methods followed by sufficient rainfall allow successful establishment of saltbush, California buckwheat, and Indian ricegrass in a very favorable year. If available, supplemental irrigation maximizes germination and increases plant establishment in most years. Once established, however, do not irrigate shrubs, except during severe drought. Seed will lie dormant if moisture is not sufficient for germination, although this does not help with short term dust control.

Successful methods of planting saltbrush *(A. canescens)* include broadcasting seed over undisturbed soil, drilling seed with a rangeland drill, and ripping and furrowing soil prior to drilling with a conventional drill. However, soil preparation by ripping and furrowing does not increase ground cover more than drilling seed without prior soil preparation.

Long term irrigation and fertilization of agricultural fields in arid environments leads to the accumulation of salts in the soil. For growers who wish to revegetate with native shrubs in fields that have potential salinity problems, choose species with high salt tolerance. Studies in the Antelope Valley have shown that saltbushes *(Atriplex spp.)* are ideal for this purpose. The three species studied were fourwinged saltbush *(Atriplex canescens),* quailbush *(Atriplex lentiformis),* and allscale *(Atriplex polycarpa).* All three species had high survival and growth rates on fallow lands and are therefore suitable choices for revegetation purposes.

Among these three species, fourwinged saltbush is likely to be the best choice across the widest range of situations. It has one of the highest salt tolerances of all saltbush species. Fourwinged saltbush can grow up to a foot per year and at maturity a single plant can cover up to 200 square feet. It has a highly branched structure, which is ideal for trapping windblown dust and sand. Fourwinged saltbush can live more than 100 years and produces large numbers of seeds, speeding the natural recovery process in abandoned fields. Also important in areas prone to windblown sand, fourwinged saltbush seed has shown the ability to germinate and emerge through 2 inches of cover.

California buckwheat established rapidly and sustained its coverage, declining briefly following drought. However, it performed well only at elevations above the valley floor.

Indian ricegrass established rapidly in the first years in many locations but then dropped out of most populations. It was most successful in deep sand and provided only minor cover in other areas. Indian ricegrass did not have the longevity exhibited by shrubs, especially under drought conditions.

Rabbit brush became well established in control plots, even without prior soil preparation and seed application, when nearby upwind populations provided a source for self-seeding. Drilling and broadcasting were less expensive than ripping and furrowing, although seed of rabbit brush is difficult to handle.

In all cases, removing tumbleweeds by burning in place or tillage is beneficial to establishment of native species. Perhaps for this reason, disking the seedbed improved plant establishment.

Range Planting

Wind erosion may be reduced on rangeland or other suitable location through establishment of adapted annual or perennial vegetation such as grasses, forbs, legumes and/or perennial shrubs and trees. This practice may be applied where desirable vegetation is below the acceptable level for natural reseeding to occur.

Wind Breaks

Wind rarely lifts sand higher than 3 feet above ground. This allows wind breaks to trap blowing sand as it enters land from upwind areas or is blown from disturbed land. Wind breaks can be solid or porous barriers. (See Figures 9 and 10.) In either case they slow the wind and cause it to drop its burden of sand.

Figure 9: Porous wind fences are commercially available. They trap blowing tumbleweeds as well as sand. In areas with endangered species, such as the desert tortoise, openings should be provided at intervals to allow for continued natural migration of the animals.

Solid Fences

Wood or concrete block fences are solid wind barriers. They collect blowing sand only on the barrier's upwind side. In general, little sand will pass the barrier until collected sand on the upwind side reaches the top of the fence. When sand begins to blow across the top, either increase fence height or remove the collected sand. Install these barriers along the upwind edge of your property.

Porous Fences

Porous plastic fences are partial wind barriers. Openings in fences slow the wind and cause blowing sand to deposit mostly on the downwind side. Because the area of sand accumulation is larger than with solid fences, its depth is reduced and sand removal is required less frequently. However, little vegetation will grow where unstable sand accumulates.

Figure 10: The combination of wind fences and seeding of cover crops such as barley may reinforce each other. Even with poor establishment on very sandy ground, the combination may suppress wind erosion enough to initiate stabilization.

These barriers may also be installed along the upwind edge of property or at intervals downwind across property. A 4-foot porous polyethylene sand fence will deposit blowing sand within about 40 feet of the fence.

Straw Bales

Straw bales are often available on farms. Use these to erect solid or (by spacing them) porous barriers. These are most effective as wind breaks when they are at least 6 feet high.

Soil Surface Modification

The soil surface can be modified by performing tillage operations that create random roughness. (See Figure 11.) Several techniques for roughening the soil surface may provide rapid suppression of wind erosion. Ripping soil to bring clods to the surface may be sufficient to disrupt wind and interrupt saltation of sand particles. Bedding or furrowing soil may also be effective, particularly across the wind. Blowing sand tends to collect in the furrow bottoms.

Figure 11: Tillage across the wind is very effective in controlling wind erosion. It may serve as an emergency measure or as preparation for seeding of native species.

Berms

Berms provide more dramatic and long-lasting soil surface modification. (See Figure 12.) They are large mounds of earth built perpendicular to the wind. They may be stabilized with wood chips, vegetation, or other covering, or with wind fences. Berms slow the wind and cause sand to deposit mostly on the downwind side.

Figure 12: Berms are semi-permanent features on the landscape that provide effective reduction of blowing sand.

Large Trees and Shrubs

Large vegetation, such as trees and shrubs, planted in a single or multiple rows, provide protection from blowing sand, similar to wind fences. (See Figure 13.) They also leave an attractive landscape feature after sand encroachment has been solved. To grow properly, vegetation needs moisture and protection from sandblasting. Plant vegetation along the downwind edge of a berm or other wind barrier. This will protect

vegetation until it matures and begins to reduce wind speed on its own.

Use trees to protect seedlings of other crops from sandblasting. However, the cost of establishing and maintaining tree covers can be high. Also, trees require supplemental water in Antelope Valley, so evaluate water availability and maintenance of irrigation systems. (See Appendix Tables A1 and A2).

Figure 13: Wind barriers made up of permanent vegetation provide effective protection from blowing sand. They are too slow for emergency applications but provide long term beautification of the landscape.

Surface Coverings

Dust control can be a problem on unpaved roads where there is vehicle and machinery traffic and on unpaved areas such as farmsteads, materials handling areas, equipment parking lots, and construction sites. Surface coverings can stabilize loose soil in these areas and may consist of almost anything that covers the sand and increases surface roughness. With the possible exception of wood chips, discussed below, these techniques would interfere with future cropping and should be avoided on land that will be returned to production.

Mulching involves applying plant residues, by-products, or other suitable materials produced off site to the land surface. Wood chips, gravel, or even plastic sheeting can be used as mulch. A thin layer (3 – 4 inches) of wood chips is a quick, easy way to temporarily stabilize small areas of accumulated sand while vegetation grows. This layer provides protection for up to 5 years. Currently, wood chips are available free of charge from municipal waste sources.

Gravel is more expensive and longer lasting than wood chips. It is most appropriate for roads and equipment yards.

Plastic mulches may be appropriate in permanent cropping systems, where they may offer additional benefits in moisture conservation and insect management.

Chemical dust suppressants are polymers that bind the soil surface, making it resistant to dislodging and saltation of sand particles. Other surface covering options include road base materials, road oils, oil and aggregates, and asphalt. For dust control, these products can be applied to roadways and equipment yards but not to production fields. The longevity and cost depends on the specific product.

For more information about dust control on unpaved roads and unpaved areas, visit WRAP at

Acknowledgments

In addition to the technical contributors listed at the beginning of this document, the following groups have supported the Dustbusters Research Group:

- Financial Contributors
- Resource Providers
- Focus Group participants

Disclaimer

Resources Guide

Antelope Valley Resources Conservation District (CA RCD) at **661-945-2604**; at website *http://www.avrcd.org/*; or email *avrcd@carcd.org*

Antelope Valley Resources Conservation District Nursery (AVRCD) at **661-942-7306**; at website *http://avrcd.org/nursery.htm*; or email *avrcd@carcd.org*

Antelope Valley U. S. Department of Agriculture Natural Resources Conservation Service (USDA/NRCS) office at **661-945-2604**

USDA/NRCS website at *http://www.ca.nrcs.usda.gov/*

Los Angeles County Agricultural Commissioner at **661-723-4485**; or at website *http://acwm.co.la.ca.us/*

Kern County Agricultural Commissioner at **661-868-6300**; at website *http://www.kernag.com/*; or email *agcomm@co.kern.ca.us.*

University of California – Los Angeles County Cooperative Extension – Antelope Valley/ Lancaster Office at **661-974-8824**; or at website *http://celosangeles.ucdavis.edu/*

Other Sources of Information:

Website URL
List of Case Studies
USDA/NRCS Practices
Publications
Reports on Website
WRAP
Extended Abstracts of Reports

Appendix: Irrigation Requirements

Table A1: Irrigation requirements for landscape trees and shrubs, expressed in gallons per tree per day, near Victorville, California.

Type of Cover Crop	Suggestions for Stand Establishment
High cost cover (cowpeas)	Place irrigation in field (if solid set) and pre-irrigate (1-2 inches, 8-12 hours). Apply 150 units of N (ammonium sulfate); this will supply needed S (adjust, if possible, based on soil test). Plant at appropriate rate and depth. (See Table 3.) Irrigate for short durations of 2 hours per day for 2 weeks; then according to evapo-transpiration. (University of California Cooperative Extension can provide information.)
Low cost cover (cereal grain or Sudangrass)	Place irrigation in field if needed or not expecting winter moisture; pre-irrigate with 1 inch. If irrigation will be limited, pre-irrigate with 2-3 inches. Irrigate 6-8 inches for season, if available. If sub-moisture is available, adjust drill depth to reach moisture. Grain will emerge from 3-4 inches deep. Apply 40 to 80 units of N only if irrigation is supplied. Do not irrigate prior to emergence because this reduces emergence. Replant if rain exceeds 0.5 inches or forms a crust. For Sudangrass, plant in May if possible. Will not emerge if planted after August. Irrigate for several weeks and fertilize for acceptable stand.

Table A2: Recommended planting procedures for selected cover crops in the Antelope Valley.

	WINTER Dec 21 - Mar 20			SPRING Mar 21- Jun 20			SUMMER Jun 21-Sep 20			FALL Sep 21 - Dec 20		
Height of Tree (Feet)	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
3	0.2	0.2	0.3	0.4	0.6	0.9	1.3	1.5	1.3	0.9	0.5	0.3
6	0.3	0.3	0.5	0.7	1.1	1.9	2.6	3.0	2.6	1.9	1.1	0.5
9	0.5	0.5	0.8	1.1	1.7	2.8	3.9	4.5	3.9	2.8	1.5	0.8
12	0.6	0.6	1.1	1.4	2.3	3.7	5.2	6.0	5.2	3.7	2.0	1.1
15	0.8	0.8	1.4	1.8	2.9	4.7	6.5	7.5	6.5	4.7	2.6	1.4
18	0.9	0.9	1.6	2.2	3.4	5.6	7.7	9.0	7.7	5.6	3.1	1.6
21	1.1	1.1	1.9	2.5	4.0	6.5	9.0	10.5	9.0	6.5	3.6	1.9
24	1.2	1.2	2.2	2.9	4.6	7.4	10.3	12.0	10.3	7.4	4.1	2.2
27	1.4	1.4	2.4	3.2	5.1	8.4	11.6	13.5	11.6	8.4	4.6	2.4
30	1.5	1.5	2.7	3.6	5.7	9.3	12.9	15.0	12.9	9.3	5.1	2.7
33	1.7	1.7	3.0	4.0	6.3	10.2	14.2	16.5	14.2	10.2	5.6	3.0
36	1.8	1.8	3.2	4.3	6.8	11.2	15.5	18.0	15.5	11.2	6.1	3.2
39	2.0	2.0	3.5	4.7	7.4	12.1	16.8	19.5	16.8	12.1	6.6	3.5
42	2.1	2.1	3.8	5.0	8.0	13.0	18.1	21.0	18.1	13.0	7.1	3.8

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USDA Soil Conservation Service
Provided courtesy of the Mojave Water Agency