D.O.Bergin

SAND-DUNE STABILIZATION

(1952-1976)

White pages: 1963-1977
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1. 764795 S0040-05651
Ten years of development of man-initiated coastal barrier dunes in North Carolina.
Woodhouse, W. W., Jr. ; Seneca, E. D. ; Broome, S. W.
North Carolina State University, Raleigh, USA.
Bulletin. North Carolina Agricultural Experiment Station. 1976. No.453. 53 pp.
Languages: En
Descriptors: soil types (ecological); coastal dune soils; stabilization
USA, North Carolina
DC No: 261.1
Subject Code: S261100
American beachgrass was nearly ideal for early stabilization and dune development, but is susceptible to several pests and is short-lived. It is eventually replaced by sea oats on most foredunes, but sea oats is difficult to propagate, slow to establish and is not very satisfactory for initial stabilization. Consequently, mixed species plantings are recommended. Mixed plantings also reduce pest and other hazards. Results and observations suggest that, in choosing foredune location, careful consideration should be given to rate and direction of dune growth and to the normal fluctuations of shorelines along sandy seashores. Experience indicates that where sand supplies and climate permit, the "growing" of foredunes through the use of suitable plantings, supplemented by sand fences, is feasible and practical. 'dagger'
27 ref.

2. 600047 S0039-05933
Dune erosion, sand drift control and community effort - Callala Beach.
Fleck, B. C.
Journal of the Soil Conservation Service of New South Wales. 1975. 31.1, 19-24
Languages: En
Descriptors: erosion; soil conservation; reclamation; soil types (physiographic); coastal dune soils; regions; Australia (specified states; territories); New South Wales; Callala Beach
DC No: (944) ; 185 ; 261.1 ; 141.631 ; 260.321
Subject Code: S260321
Dune erosion occurred at Callala Beach as a result of extreme storms during May and June 1974, and because the guidelines for development along coastal dunes, proposed by the Soil Conservation Service, had not been followed. However, action was taken rapidly by the residents and community helpers, both during and after the storms. Marram grass has been established over the seaward face of the frontal dune to trap wind-blown sand as it returns to the beach from the off-shore sand bar. This will lead to gradual reformation of the frontal dune.

3. 457032 S0038-04211
Problems arising from the intensive use of coastal dunes in New South Wales, Australia.
Atkinson, W. J.
Environment Protection Division, Department of Environment & Conservation, Canberra A.C.T., Australia.
International Journal of Biometeorology. 1974, 18.2, 94-100
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; Australia (specified states; territories); New South Wales
DC No: (944) ; 261.1
Subject Code: S261100
Reclamation of drift areas and of areas endangered by human activity is described, including engineering methods and stabilization by Spinifex hirsutus or Ammophila arenaria. Restoration following mining includes the planting of a cover crop, usually Secale cereale or a sorghum hybrid, which encourages regrowth of native plants. Fertilizer is an aid to revegetation.

4. 415225 S0038-02405
Progress in coastal sand dune reclamation in Queensland, Australia.
Barr, D. A.
Harbours and Marine Department (Beach Protection Authority), Box 2195 G.P.O., Brisbane, Queensland, Australia.
International Journal of Biometeorology. 1974, 18.2, 137-141
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; Australia (specified states; territories); Queensland
DC No: (943) ; 261.1
Subject Code: S261100
Methods of rapid establishment and growth of Spinifex hirsutus, the major coloniser, have been improved, and the role of other plants is under evaluation. Three types of sand-dune fences were all effective in building up sand dunes. The brush matting technique has been shown to be more effective than straw, bitumen emulsion and PVA mulches under exposed conditions. Ecological and climatological studies are also in progress.

5. 447260 S0038-03645
Sand dune stabilization at El Aaiun - West Sahara.
Benito, G. A. de
ESSO Standard Espanola S.A., Fortuny, 18-Madrid-4, Spain.
International Journal of Biometeorology. 1974, 18.2, 142-144
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; mulching materials (specified); petroleum mulches; regions; Spanish Sahara; El Aaiun
DC No: (648) ; 261.1 ; 218.7

Subject Code: S26110021
A contract was arranged with a phosphate mining company for the task of stabilizing for 20 years a moving dune system where it intersects for a distance of nine miles with the conveyer belt from the mine. A 750-sec petroleum oil was sprayed at rates of 4-8 t/ha, the main problem being unloading of the oil at the site of use; results have been good. Revegetation trials have been commenced, using a surface layer of petroleum oil.

6. 437288 S0038-02998
An ecological approach to dune management in the National Recreation Areas of the United States East Coast.
Godfrey, P. J. ; Godfrey, M. M.
Department of Botany, Massachusetts University, Amherst, USA.
International Journal of Biometeorology, 1974, 18.2, 101-110
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; USA (specified states); Massachusetts; North Carolina
DC No: 261.1 ; (744) ; (756)
Subject Code: S261100
Problems of dune stabilization and beach management at Cape Cod in Massachusetts and at Cape Lookout and Cape Hatteras in North Carolina are discussed.

7. 457033 S0038-04212
Fixation of the dunes of Gascony in France.
Guinaudeau, J.
Centre National de Recherches Forestieres de Bordeaux, Domain de l'Hermitage, Pierroton, 33 Cestas, France.
International Journal of Biometeorology, 1974, 18.2, 133-136
Languages: Fr
Descriptors: reclamation; land types (specified); sand dunes ; regions; France; Gascony
DC No: (44) ; 261.1
Subject Code: S261100
The history of the dunes is outlined together with measures used in the past for fixation; a stable wooded system had developed by 1880. Problems encountered in the twentieth century have been encroachment of the maritime pine plantations by broadleaf trees and shrubs, and degradation of the coastal dunes. Measures undertaken from 1958 onwards to stabilise the coastal dunes are recorded.

8. 415226 S0038-02406
Plants and techniques used for sand dune reclamation in Australia.
Mitchell, A.
Soil Conservation Authority, Kew 3101, Victoria, Australia.
International Journal of Biometeorology. 1974, 18.2. 168-173
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; Australia
DC No: 261.1 ; (94)
Subject Code: S261100
The use of mechanical reshaping, drift fences, brush matting, mulching or an adhesive spray, and planting and choice of species for coastal and inland dune reclamation are described. Subsequent management may include fertilizer application, careful grazing and vermin control, to ensure that a good vegetative cover is maintained.

9. 415224 S0038-02404
Drift sand reclamation of Walvis Bay, South West Africa.
Roux, P. J. Le
Department of Forestry, P.O. Box 333, Grootfontein, South West Africa.
International Journal of Biometeorology. 1974, 18.2. 121-127
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; South Africa; Walvis Bay; soil types (chemical); saline soils
DC No: (68) ; 261.1 ; 266
Subject Code: S261100
Problems encountered in the control of the Walvis Bay sand, which migrates along the shore due to the Benguela current, are the low annual rainfall (11 mm), the aridity, the strong prevailing S-SW winds, the frequent saline fogs, and the high salinity of the soil and groundwater. Some success has been achieved with gravel, coal-ash or oil; by pole barriers, use of Atriplex species of very high salt tolerance, and of other species which will grow in dune sand irrigated with reclaimed sewage water.

10. 447261 S0038-03646
Some experiences from attempts at establishing broadleaved woody plants in some Danish dunelands.
Schlatzer, G.
Desert Arboretum, Hvedde, Kibaek, Denmark.
International Journal of Biometeorology. 1974, 18.2. 159-167
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; Rosa spp.; regions; Denmark; Jutland
DC No: 261.1 ; (489) ; 497.344
Subject Code: S26110049
Climatic data, soil properties, trial layout and fertilizer usage in Jutland dune reclamation trials are recorded, and attention is given to the use of Rosa rugosa and R.virginiana. The growth of these plants in relation to factors such as soil pH, water table level and exposure was examined with particular reference to stolon production.

11. 386307 S0038-01126
Stabilization of aeolian sands in Saudi Arabia's Al Hasa Oasis.
Stevens, J. H.
University of Durham, Durham, UK.
Journal of Soil and Water Conservation, 1974, 29.3. 129-133
Languages: En
Descriptors: reclamation; land types (specified); duneland; regions: Saudi Arabia; Al Hasa Oasis
DC No: (532) ; 261.1
Subject Code: S261100
(261.1) The sand stabilization scheme involved establishment of the fast-growing Tamarix aphylla on levelled dunes over which a saline soil had been spread for initial stability. Soil formation on the reclaimed areas, including changes in physical properties, organic matter and soluble salt content, is described.

12. 437287 S0038-02997
Sand dune stabilization in Israel.
Tsuriel, D. E.
Soil Conservation Service, Ministry of Agriculture, Hakirjah, Tel Aviv, Israel.
International Journal of Biometeorology, 1974, 18.2. 89-93
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; regions; Israel
DC No: 261.1 ; (569.4)
Subject Code: S261100
The effectiveness of Ammophila arenaria in fixing sand in a reclamation scheme for industrial development is recorded. Agropyron junceum, Lotus creticus and Retama roetam were less effective at the initial stage but eventually created a good sod. Rows sown parallel to the prevailing winds were more effective than rows sown at right angles, since plant injury was reduced. Spraying of bituminous emulsions was also helpful.

13. 467040 S0038-05057
New Zealand experience in stabilization and afforestation of coastal sands.
Wendelken, W. J.
New Zealand Forest Service, Wellington.
International Journal of Biometeorology, 1974, 18.2. 145-158
Languages: En
Descriptors: reclamation; land types (specified); sand dunes ; forestry practices (specified); afforestation; regions; New Zealand
DC No: (931) ; 261.1 ; 492.33
Subject Code: S26110049
Areas of coastal sand, their climate and natural vegetation, and a history of measures taken this century to stabilise the dunes are described. After preliminary stabilisation, tree

planting is undertaken, for which Pinus radiata is the best species: it is very resistant to salt-laden wind exposure and produced a good income from timber. Cultural practices for growing this tree on the dunes are described.

14. Cooldrake, J.E.; McKay, M.; Roe, P.A. Annotated bibliography on the ecology and stabilisation of coastal sand dunes, mining spoils, and other disturbed areas. Preliminary list. (1972) 132 pp CSIRO Division of Plant Industry, Brisbane, Australia.

A bibliography of 485 references with an emphasis on work applicable to Australia.

15. Augustine,M.T.; Sharp,W.C. 1969. Effect of several fertilizer treatments on the production of American beachgrass culms. Agron.J 61, 43-45. [U.S.Dep.Agric., College Park, Md]

Each of 17 different fertilizer treatments significantly increased culm production in Ammophila breviligulata Fern. (used fo dune stabilization). K increased production in the first year only Annual fertilizing with soluble N was effective. Magnesium ammoniu phosphate applied at planting only increased culm numbers for 3 yr, then decreased in effectiveness to approach that of annual applications of mixed 10-10-10 mineral fertilizer.

16. Barr,D.A.; Golinski,K.D. 1969. Marram grass, mulch and bitumen - a successful trial. J. Soil Conserv. N.S.W. 25, 251-257.

Marram grass (Ammophila aronaria) was planted on bare re-shaped areas and covered with a mulch of marram grass tops. Fertilizer (18:18:0) was applied at 121lb N/acre followed by bitumen emulsion spray at 200 gal/ac

17. Ibrahim, K.M. 1969. The control of drifting sands in the north coastal region of U.A.R. Pakist.J.For.19, 456-471. [Desert Inst., Cairo, U.A.R.]

The physical characteristics of blown sand which form the different types of dunes are described and methods of control are briefly reported.

18. Savage,R.P.; Woodhouse,W.W. 1969. Creation and stabilization of coastal barrier dunes. Proc.11th ostl Engng Conf.,London, 1968, 671-700.

Experiments are reported from North Carolina where sand fences an dune grasses are being used to create and stabilise a barrier dune lin parallel to and behind the existing beaches of low lying barrier islands. A vigorous, rapidly-growing strip of American beachgrass, 90 ft wide, will trap and retain all of the sand being transported by the wind in the area. 2 workable methods of using sand fences to create large dunes are described. The use of fabric as sand fences was also investigated; their effectiveness varied with the porosity of the fabric.

19. Stopănescu,E.; Colibaş,M.; Mihăilescu,V. 1969. [Preliminary results on the feasibility of sand dune shaping in the North-West of Rumania, and on the changes in some physico-chemical properties.] Anal. Inst. Cerc. Îmb. Func., Ser. Îmb. Func. 2, 99-116. [Rm.e.f.r.]

Levelling increased the clay content from 3.01 to 5.46% and reduced the field capacity by 3%. There was also a reduction in infiltration rate, mostly in the interdunes. The pH was increased from 5.91 to 6.67; the cation-exchange capacity from 2.40 me to 5.88 me and the base saturation by 3%. The mobile P_2O_5 content was also slightly increased.

20. Bisal, F. 1968. Influence of plant residue on sand flow in a wind tunnel. Can.J.Soil Sci.48, 49-52. [Res.Stn, Canada Dep.Agric., Swift Current, Saskatchewan]

A wind tunnel was used to study the effect of varying amounts of standing wheat stubble on sand flow. Generally the relationship between sand flow and the amount of wheat stubble tended to be sigmoidal; there was an initial phase when small amounts of stubble had very little effect on sand flow, and this stage was followed by a very rapid decrease in flow if additional increments of stubble were added to the surface. Sand flow approached zero at stubble rates ranging from 1200kg/ha for a wind velocity of 5.36m/sec to 7200kg/ha for a wind velocity of 8.49m/sec. At a wind velocity of 10.28m/sec adding 1800kg/ha wheat stubble tended to increase sand f

21. Eck, H.V.; Dudley, R.F.; Ford, R.H. et al. 1968. Sand dune stabilization along streams in the Southern Great Plains. J.Soil Wat.Conserv.23, 131-134. [Soil Wat.Conserv.Res.Divn, Agric.Res. Serv., USA]

Trials on Tivoli fine sand on active dunes in Texas and Oklahoma showed that fertilizer was needed for revegetation, for which native grass species were most suitable. Anchored hay was a satisfactory mulch, asphalt was not.

22. Khan, C.M.A. 1968. Sand dune rehabilatation in Thal, Pakistan. J.Range Mgnt 21, 316-321. [W.Pakistan, For. Serv., Bhakkar]

Sand dunes were rehabilitated in 3-year trials by planting Cenchrus ciliaris and Elyonurus hirsutus in tufts. The winter-fodder tree Zizyphus jujuba was established, without watering, by planting at 10-25/acre in open-bottomed baked-clay tubes 12 in.long and 4.5 in.diameter. Wind erosion, it is claimed, should be checked by these fast-growing trees within 2 years.

23. Zak, J.M. 1967. Controlling drifting sand dunes on Cape Cod. Bull.Mass.agric.Exp.Stn 563, pp 15.

Five experiments are described: the establishment of drought-resistant plants from seed for the stabilization of sand dunes with the aid of various mulches; establishment of American beachgrass (Ammophila breviligulata) for dune stabilization; establishment of permanent cover using shrubs and woody plants; use of oil-base mulches and sand terraces to aid tree and shrub establishment on coastal dunes.

24. Yakubov, T.F.
1966. [Mediterranean coastal sands of the Libyan desert.]
Pochvovedenie No.6, 96-104. [R.]

A general description of the soils and vegetation of the Libyan coast, with special reference to sand-dune formation and utilization.
-G.V.J.

25. Barr, D.A. 1965. Restoration of coastal dunes after beach mining. J. Soil Conserv. Serv. N.S.W. 21, 199-209. [Sand Drift Control, Kempsey]

Methods used in stabilizing coastal sandy areas after mining for rutile and zircon are described. They include the stripping and stockpiling of topsoil, the stripping and placement of overburden, the placement of tailings, the levelling and contouring of tailings, the replacement of topsoil, and the establishment of a vegetative cover and fertilizing. Tables give species, propagation and location of primary (grasses), secondary (creepers and shrubs) and tertiary (trees) stabilizers.

26. Blankwaardt, H.F.H.
1965. Polyphylla fullo L. (Col., Melolonthidae) in the dunes.
Netherlands J. agric. Sci. 13, 72-80. [E.]
[Inst. Biol. Field Res., Arnhem]

It is possible to reduce the loss of young saplings to a third by dipping the roots in Aldrin emulsion before planting; addition of Aldrin dust to the planting hole will eliminate almost all grub damage. Fairly good results follow if this treatment is combined with narrow spacing to ensure quick plant cover; vegetative growth might be hastened by fertilizing.

27. Cahiers des ingénieurs Agronomes.
1965. [Fixation of sand dunes with thin rubber films.]
Cah. Ingnrs agron. 200, 18-20. [F.]
Abs. in Mon. analyt. Bull. Inter-afr. Bur. Soils [15-208]
The product considered is composed of synthetic latex and watery emulsion mixed with an appropriate oil solution. It is convenient to store, transport, and spray and produces a film easily penetrated by germinating plants. 40-50 g/m^2 is sufficient; the adhesive process occurs in about four hours but maximum adhesiveness is attained in about four days.

28. Gabai, V.S.
1965. [Polyacrylamide and stabilization of shifting sands.] Moskva
Vestn. s.-kh. Nauki No.7, 33-37. [R.e.g.f.]

Covering 10% of the area of shifting sands in the Volga and Stavropol regions with polyacrylamide stabilizes the sands. Acry-

lamide can be applied as a powder to snow on all kinds of relief and in liquid form to difficultly accessible places and in summer. It improves soil properties and forms a waterproof crust 5 cm thick which persists for 2 years. The crust does not impede seedling emergence or infiltration of precipitation.

29. Augustine, M.T.; Thornton, R.B.; Sanborn, J.M. et al.
1964. Response of American beachgrass to fertilizer. J. Soil Wat. Conserv. 19, 112-114.

Ammophila breviligulata Fern is the best plant for stabilizing frontal dunes along the U.S. mid-Atlantic coast. Fertilizer-application methods included banding and placement at the bottom of the planting furrow. The first year's results indicate that single spring applications of NH_4 or NO_3-N, urea-formaldehyde with or without PK slightly increased culm production. Rather larger increases were given by conventional NPK mixtures applied in autumn and spring. Best results were given by a single autumn application of $MgNH_4PO_4.H_2O$+K. There was no difference in fertilizer response or survival between "nursery"-grown or native planting materials. Total number of culms produced varied only slightly when 1,2 or 3 culms were planted per planting hole.

Haas, J.A.; Steers, J.A.
1964. An aid to stabilization of sand dunes: Experiments at Scolt Head Island. Geogr.J. 130, 265-267.

Application to sand dunes of a film of synthetic rubber in which mineral oil was incorporated produced sufficient stabilization

to allow germination and growth of grasses. The film was effective under exposure to sunlight for 6 months and resisted erosion from occasional covering by sea water.

31. Bolotin, M.
1963. Growth of eucalypts on dune sand as related to soil profile. Contr.Eucalypts Israel II, pp 13-17. [E.] F.A. 25 [3295].

In sand-dune afforestation with Eucalyptus gomphocephala and E. rostrata poor growth was caused by nutrient-deficient sands of low waterholding capacity to 3 m depth and a colloidal dark-brown hardpan containing much decayed organic matter and potsherds which did not release moisture into the top layer. Good growth was associated with a layer of brown loamy sand below the top sand.

32. Lachover, D.; Tsouriel, D.; Beresky, A.
1963. [Foliar sprays of nitrogen fertilizers to Agropyrum junceum growing on dunes.] Agron. trop. Paris 18, 185-191. [F.e.sp.]

Foliar sprays of a compound fertilizer (6.25-12.5% each of N & P_2O_5) or solutions of NH_4NO_3 or urea (in this decreasing order of efficiency) considerably increased the yield & protein content of Agropyrum grown for fixing shifting sand-dunes, as compared with plants receiving $(NH_4)_2SO_4$ in solid form.

COMMONWEALTH BUREAU OF SOILS

HARPENDEN, ENGLAND.

Bibliography on

SAND-DUNE STABILIZATION
(1952-1962)

1. Brown, R. L.; Hafenrichter, A. L.
1962. Stabilizing sand dunes on the Pacific coast with woody plants.
U.S.D.A. Soil Conserv. Serv. misc. Publ. 892, pp 18.

2. McMullan, J. L.
1962. Stilling coastal sand drifts with marram grass.
J. Dep. Agric. W. Aust. 3, 252-255, 258-265.

3. Dubrovskiĭ, V. P.
1960. [Establishment of vegetation on the sands of western Turkmenia by means of application of bitumen.]
Trudy turkmen. nauch.- issled. Inst. Zhivotnovod. Veterinar. 2, 139-159. [R.]

Application of a 5-30% bitumen emulsion at 1 t/ha directly before sowing or planting black haloxylon produced a crust 3-10 mm thick, which was not destroyed in dry or moist sand by wind velocities up to 25 m/sec. With the appearance of vegetation the crust was not destroyed by wind velocities up to 35 m/sec. The crust increased the density of the sand from 1.55 g/cc to 1.67 g, decreased the permeability to air by 8% and the permeability to water by two-thirds, and increased the soil-moisture content in the top 100 cm by 15-30% and the soil temperature at the surface. Bitumen improved plant growth.

4. Kidson, C.; Carr, A. P.
1960. Dune reclamation at Braunton Burrows, Devon.
Chart. Surveyor, Dec. 1960, 3-8.

An account of the stabilization measures undertaken after extensive damage to these dunes and widespread formation of blowouts. Changes in the dunes occurring between 1885 and 1957 are described.

5. Vágó, M.
1960. [The establishment of lucerne on acid drifting sands.]
Kisérl. Közlem. 53A, 75-87. [Hu.r.g.]

Bitter lupin is sown in early spring to soil dressed with 85 kg/ha, N fertilizer (Pét salt), 260 kg super and 170 kg potash; the green manure is plowed down to medium depth (together with the same amounts of fertilizers as before) in early summer, and the lucerne is sown in mid-August in soil kept free of weeds.

6. Westsik, V.
1960. [Experiments with deep-layered manure on dune sand.]
Magy. Mezögazd. 15, 20-21. [Hu.]

To prevent wind-blowing of upturned sand, a first layer of manure should be placed to 60 cm depth in August of the first year and another layer to 40 cm in the following year. Rye for seed production should be grown as a wind shield until the first row crop is grown. Where farmyard manure is lacking, green manure may be turned down to 40-60 cm depth, followed by harrowing and incorporation of a thin layer of straw.

7. Ahmad, S.
1959. An international study on the arid-zone land use problems. Part II. Pakist. J. For. 9, 96-117.

An account of the development of arid and semi-arid areas (Stalin plan in Russia, Thal project in Pakistan), of dry afforestation in various parts of the world (India, Pakistan, Israel, North Africa, Russia, United States), and of sand-dune fixation. 143 references.

8. Maheut, J.; Doumergues, Y.
1959. [Sand-dune fixation by afforestation on the Cape Verde peninsula and the biological development of the soil.]
Bois For. Trop. 63, 3-16. [F.e.sp.]

This account of successful afforestation with Casuarina equisetifolia includes descriptions of topography, climate, soils etc., nursery techniques (e.g., using polythene tubes which produce a long-rooted stock) spacing, irrigation and protection against blowing sand and grazing animals. Height at 9 years was 13-14 m; the distance protected was ten times the height of the trees. Biological activity of the soil was greatly increased, but laboratory experiments with a similar but more developed soil (from the interior) enriched wich C. equisetifolia or Cassia litter, indicated a lack of N-cycle bacteria and no N-mineralization took place in the Casuarina sample. It is suggested that in the second generation Casuarina should be replaced by other species e.g., Cassia.

9. Muravsky, E.; Romati, B.
1959. Utilization of sewage water to irrigate crops on shifting sands.
Bull. Res. Coun. Israel 8G, 162.

Sand irrigated with urban sewage became quite stable after one growing season and was sufficiently fertile to support crops, especially lucerne and pasture plants. Organic matter in the upper layer was substantially increased but with continued irrigation no accumulation of salts was observed. There appeared to be no need of animal manure but P amendments were beneficial. A variety of forage crops developed well and yields were comparable with those from fertile soils.

10. Bennion, J. E.
1958. The reclamation of Stockpoole Warren.
Agriculture Lond. 65, 435-438.

The conversion of sand dunes in Pembrokeshire into sheep country is described.

11. Carmen, M.
1958. [Preliminary study of the stabilization of sands of the Pasamayo highland by planting Tillandsia.]
Inf. Estac. agric. La Molina No. 370, 1-9. [Sp.]

T. latifolia, but not T. purpurea, appeared well adapted to the area, the sands of which were of similar chemical composition to the native coastal sands, although the soil temperatures attained were considerably higher. T. latifolia effectively stabilized sands moving from a slope.

12. Moldenhauer, W. C.; Coover, J. R.; Everhart, M. E.
1958. Control of wind erosion in the sandy lands of the southern high plains of Texas and New Mexico.
USDA ARS 41-20, pp 13.

13. Pearse, H. C. H.
1958. Stabilisation of sand drifts with blue lupins.
N.Z. J. Agric. 97, 315-323.

Blue lupins established well when drilled, grew vigorously without fertilizer and reseeded freely on loose windblown sand at any depth. They have not been adequately tested on exposed seaward dunes.

14. Satyanarayan, Y.
1958. Indigenous species in the stabilization of sand dunes of Rajasthan Desert.
J. Soil Wat. Conserv. India 7, 47-51.

P.T.O

In the southern and western parts [illegible] and shifting sands form an important problem since blowing of sand towards the interior means encroachment by the desert. Covering with grass is the best method of control. A list is given of indigenous species which might be tested, and other grasses and legumes which bind sand, improve fertility and provide good grazing are discussed.

15. Shipman, R. D.
1958. Planting pine in the Carolina sandhills.
S. East. For. Exp. Sta. Pap. 96, pp 43.

The seed source for Pinus pulustris, its nursery treatment, site preparation, planting and early tending are discussed. Prescriptions are given for various soils and soil preparations to produce a given plant percentage. Chief recommendations are to plant (preferably by machine) high-grade seedlings root-pruned and with foliage clipped, in winter, on scrub oak sites after complete clearing or furrowing and on old fields after furrowing, plus chemical control of competing vegetation.

16. Sloss, J. E.
1958. Coastal sand drift. Part II. Control measures.
J. Soil Conserv. N.S.W. 14, 50-68.

17. Blencove, J. P.
1957. Stabilizing mallee sandhills.
J. Agric. S. Aust. 60, 235-237.

Rye combine-sown at the rate of 40 lb/acre gave good results in the control of wind erosion.

18. Calder, R.
1957. Desert research in Israel.
New Scientist 3, No. 58, 8-9.

Tamarisk should not be used indiscriminately for regenerating and anchoring dunes. It is an indigenous desert plant, but will suck all the stored moisture out of the dunes and may set them adrift.

19. Ito, K. et al.
1957. [Studies on the improvement of steep slopes under sasagrass (Pleioblastus variegatus Makino). 1. On erosion control and the introduction of lespedeza, (Microlespedeza striata Makino).]
Bull. Shikoku agric. Exp. Sta. 3, 47-64. [J.e.]

Steep slopes covered with sasagrass were improved by: contour trenching; contour cultivation; reseeding with Eragrostis spp., Lolium multiflorum, Lespedeza spp. and Vicia sativa; manuring; cutting. Cutting twice a year gave a higher total yield of herbage than cutting once a year. The introduction of Lespedeza spp. improved the yield of forage in the following year.

20. Mullick, S. P.
1957. Coastal plantations and technique of sand fixation on the coasts of Midnapore district, West Bengal.
Indian For. 83, 97-100.

Casuarina equisetifolia is planted and when established is sometimes underplanted with Anacardium occidentale (cashewnut) and Acacia auriculiformis (Tan Wattle).

21. Nanda, P. C.
1957. Make the sands stay.
Indian Fmg 7, 34-35.

At first the creeper Ipomoea biloba is planted and soon other species appear. After a year or two casuarina and cashewnut are planted.

22. Petrov, M. P.
1957. [Improvement of sand deserts in the USSR by establishment of vegetation.
Ann. Geogr. 357, Sept.-Oct., 397-410.

Measures to arrest the extension of the drifting sands include regulation, and in some cases prohibition, of exploitation of the vegetation. Measures aimed at improving the drifting sands include vegetating them, establishment of wind breaks, and spreading of a bituminous clay film which cements the grains of sand without impeding water infiltration or germination.

23. Poupon, J.
1957. [An experiment in drifting sand fixation in the extreme South of Madagascar.]
Bois For. Trop 55, Sept.-Oct. 10-19.

A series of windbreaks perpendicular to the wind direction was established, consisting of wattle fencing permitting accumulation of sand to a depth of 0.50 m. The fence was then raised again until the sand bank was transformed into a stabilized soil.

24. Prakash, M.
1957. Conservation of shifting sands along railway lines in Rajasthan Desert.
J. Soil Wat. Conserv. India 5, 178-182.

Planting various tree and shrub species has stabilized the dunes.

25. Ravikovitch, S.: Ramati, B.
1957. The agricultural utilization of shifting sands and the effect of crops upon them.
Ktavim 7, No. 2/3, 83-105.

Data on mechanical and chemical composition of the coastal sands in Israel are given. Amelioration of the sands was based on the use of irrigated soil-building crops supplied with manure and fertilizers + trace elements. Irrigation water was applied to light soils. Lucerne, sown pasture and clover developed well and improved the physical and chemical properties of the sands; their organic-matter content, colloidal-fraction content, field water capacity and capillary porosity increased, infiltration rate was decreased, aggregation of sand grains into crumbs and clods took place and the population of micro-organisms increased. The colour of the sand changed from light yellow to reddish brown. Addition of clay soil did not help in amelioration.

26. Sless, J. B.
1957. Control of sand drift in beach mining.
J. Soil Conserv. N.S.W. 12, 164-176.

Beach mining for rutile, zircon and other minerals in marine sands has led to serious sand drift. Disposal of the overburden, re-shaping of dunes, brush fences and barriers, replacing of top soil, mulching and grass planting are discussed. A list is given of grasses, shrubs and trees suitable for stabilizing the sand.

27. United States Beach Erosion Board
1957. Dune formation and stabilization by vegetation and plantings.
U.S. Beach Erosion Bd tech. Memo. 101, pp 47.

Plants for dune stabilization in various climatic zones are listed and discussed.

28. Van der Westhuyzen, J. J. N.
1957. Combating sand dunes at Port Edward. Trees and shrubs used in cultivation.
Emg S. Afr. 33, 37-39.

P.T.O.

The shrubs Osteospermum, Brachylaena discolor and Stoebe vulgaris and the trees Casuarina equisitifolia, Pinus pinaster, Acacia cyanophylla and Acacia cyclops are suitable for planting at the sides of dunes as is also the grass Digitaria sanguinalis (Crab grass). Casuarina equisitifolia, crab grass and Frangipani trees are about the only species growing well between the dunes.

29. Conway, M. J.
1956. Mechanisation in sand dune afforestation.
Emp. For. Rev. 35, 143-148.

For the sand-dune country there are four schemes based on establishing permanent cover on the foredunes using marram grass and yellow lupins. Comparison of two methods is made and developments are described of planting machines adapted to the particular purpose.

30. Couppis, T. A.
1956. Reclamation of sand dunes with particular reference to Ayia Erini sand drifts, Cyprus.
Emp. For. Rev. 35, 77-84.

The planting of wattle (Acacia cyanophylla), stone pine (Pinus pinea), canes and tamarix is described. Water is not a serious limiting factor to survival of stone pine because of its long tap root. Soil temperatures can be decreased for young seedlings by ridging the ground or by covering it with pale-coloured soils such as chalk which absorbs less heat than sand does.

31. Wright, D. W.
1956. Profile development in the sand dunes of Culbin Forest, Morayshire.
J. Soil Sci. 7, 33-42.

Chemical analysis has shown considerable redistribution of major nutrients in the soils after fixation of the dunes, brought about by uptake of nutrients by the trees and subsequent return as litter. Samples were taken from 12-year-old, 22-year-old and 45-year-old Corsican-pine plots, an 80-year-old Scots-pine plot, a 40-year-old birch plot, a recently planted thatched dune, and the flat summit of a moving dune. Analytical results are shown in graphs, and tabulated data show the apparent density of the soil samples and the influence of grain size on the nutrient content of the soil. Incorporation of organic matter from litter into the upper layers of the profile reduces their apparent density, and nutrient content is expressed on a volume basis. In the fixed dunes Ca content was 40-55 mg per litre soil, compared with 65-85 mg in unweathered dunes. Thatching increased available Ca in the top 6 inches. P and K show similar trends. There is little increase in Mg content of surface soil except under the oldest trees; the content under birch is very low. Na is plentiful in the sand, is not taken up in large amounts by the trees and is subject to leaching. There was little increase in available bases with decreasing grain size, but available and total P increased markedly in the smallest fractions. The nutrient content of the litter depends more on species than on the nutrient status of the site. It varies throughout the year; Ca, K, Na and Mg contents fall in July-August.

32. Beare, T. A.
1955. Sulphate of ammonia on drifting sandhills.
J. Dep. Agric. S. Aust. 58, 244-245.

Application of 14-28 lb/acre $(NH_4)_2SO_4$ in conjunction with 1 cwt super, but not this super alone, promoted the early growth of rye on mallee sandhills and resulted in the stabilization of drifting sand. Total growth on piled-up sand was much greater than on blow-out areas with a few inches of sand on the exposed limestone or sandy clay.

33. Dobrunova, L. G.; Gladyscheva, O. M.; Lukicheva, E. L.
1955. [The use of mineral fertilizers during afforestation of hilly sands in the North Pre-aral district.]
Trudy Inst. Lesa Akad Nauk SSSR 24, 89-100. [R.]

P.T.O.

Experiments in 1950-52 showed that moisture conditions in the depressions between dunes are favourable for the growth of Lombardy poplar, elm and oleaster which develop strong horizontal roots. Fertilizers increased tree growth 2-5 times and increased frost resistance. Lombardy poplar responded to N and P and oleaster to P and K.

34. Jacques, W. A.
1955. Possibilities of pampas grass on coastal sand in Wellington province. N.Z. J. Agric. 90, 599-604.

Pampas grass can be grown on the stabilized dairying land to leeward of the foredune and the unstable area of sand. In the unstable area, pampas grass can be grown only where there is sufficient shelter or local stability to ensure early establishment and vigorous growth.

35. Jolliffe, W. H.
1955. Tree growing on sand dunes.
N.Z. J. Agric. 91, 52-53.

Two to four years after planting marram grass, often in conjunction with yellow lupins, sand becomes sufficiently stabilized to be planted to species tolerant to salt-laden winds (Cupressus macrocarpa, Pinus radiata, P. laricio, P. muricata, P. pinaster and Robinia pseudacacia). They are deep-rooting in sands and resist wind and drought. The stands are bounded by firebreaks carrying Mesembryanthemum and Tetragonia, preventing the sand from blowing.

36. Sipkes, C.
1955. [Sandbanks, green beaches and the silting up of our estuaries.] Tijdschr. Ned. Heidemaatsch. 66, 71-82. [Du.e.]

Natural dune formation, stabilization by planting with suitable grasses and other plants, and the effects of rabbits and other wild life are described.

37. Wright, T. W.
1955. Profile development in the sand dunes of Culbin Forest, Morayshire.
I. Physical properties.
J. Soil Sci. 6, 270-283.

Trees have had no measurable effect on the mechanical composition of recently afforested sand dunes, apart from the deposition of litter. While the moisture content of the unplanted dunes remains high throughout the growing season, the growth of trees dries out the sand considerably. The abnormally coarse texture of the soil prevents evaporation from the bare soil, since the almost complete absence of silt and clay reduces the capillary pore space and limits the capillary rise of moisture. If drying continues after the sand has been dried to the limit of capillary rise the consequent increase in tension finally breaks the liquid-moisture film in the smallest pores. Further movement of moisture across the dry zone thus formed can occur only by vapour transfer. Moisture loss is thus small and the moisture level of the underlying sand remains above wilting point until rain again falls. The total moisture-holding capacity of the upper soil in older stands of trees is greatly increased by incorporating organic matter. The maximum observed capillary rise in sand devoid of organic matter was 2 inches. Young Corsican pine planted on the thatched dunes had a tap root of at least 3 inches, but had at least part of the root system in a zone of sufficient moisture-holding capacity. Failure from drought in early years is not due to lack of soil moisture, but to burial of trees by moving sand or the removal of sand by blowing; both are eliminated by adequate thatching which also conserves soil moisture. Young trees remove considerable quantities of water from the soil, but after the closure of the canopy the addition of humus to the upper layers of sand, from the litter layer, increases the moisture-holding capacity. The amount of soil water decreases as the trees mature. Thatch laid in a continuous layer <1 ft thick has an insulating efficiency approaching that of trees 8-12 ft high.

38. Hewitt, B. R.
1954. Coastal sand drift investigations in New South Wales.
J. Soil Conserv. N.S.W. 10, 45-56, 90-96.

P.T.O.

A discussion of the factors affecting the build-up or erosion of beaches and of the means of stabilizing and revegetating sand drifts.

39. Smith, B. A. J.
1954. Development of sand dune country.
N.Z. J. Agric. 88, 236-240.

Scrub clearance and pasture establishment are described for the W. coast of North Island, New Zealand.

40. Thaarup, P.
1954. The afforestation of the sand dunes of the Western Coast of Jutland, Denmark.
Advanc. Sci. 11, No. 41, 38-41.

41. Zakharov, N. G.; Revut, I. B.
1954. [Stabilization of shifting sands by means of bitumen emulsion.]
Pustyni SSSR i ikh Osvoenie 2, 449-464. [R.]

Bitumen emulsion diluted with water is poured onto sand sown with tree seeds or planted with tree seedlings.

42. Gupta, R. S.
1953. Rajathan desert soils and their bearing on afforestation problems of the tract.
J. Soil Water Conserv. India, 1, No. 4, 30-36.

The area consists of high sand dunes forming ridges with extensive sand deposits and with rocky hills in some places or areas where sand has become stabilized and fertile soil has been built up due to admixture with clay and organic matter. Tabulated data show the salt content as chlorides, carbonates and sulphates; nitrates in ppm, pH and percentage of clay in 44 soil samples. The salt content and particularly the alkali chlorides are not sufficiently high to be toxic to plants. A slight amount of carbonates is likely to form Na clay which may slow down the rate of rainwater percolation and help in retention of water in this area where rainfall may be only 4-5 inches a year. Alluvial soil, subject to inundation by river water, contains clay and alkali salts which give rise to Na-clay formation which leads to waterlogging. Nitrate content varies from 1 to 7 ppm.

The sand dunes are not shifting, and with the exclusion of grazing animals and the encouragement of natural vegetation the area can be afforested.

43. Leone, G.
1953. Origin and reclamation of the dunes in Tripolitania.
Desert Res. Proc. int. Symp. 1952, 401-403.

44. Mort, G. W.; Hewitt, B. R.
1953. Vegetation survey of the marine sand drifts of New South Wales. 3. Some remarks on useful stabilising species.
J. Soil Conserv. Serv. N.S.W. 9, 59-69.

45. Saccardy, L.
1953. [Stabilization of dunes on the Mediterranean coast of North Africa.]
Colloq. int. Cent. nat. Rech. sci. 35, 277-286. [F.e.]

A list is presented of plants suitable for a protective cover on moving surfaces of sand.

46. Idia
1952. [Experiment in dune stabilization at Quemú-Quemú (Eva Perón) and Henderson (Buenos Aires).]
Idia Nos. 59-60, 12-13. [Sp.]

Rye was successfully used in one sowing to stabilize a dune as large as a house, and an enormous dune covering 40 ha was stabilized in stages, sowing rye in sections of about 4 ha beginning with the most favourable sections.

47. Idia
1951. [Dune fixation in Catrilo and Toay.]
Idia Nos. 59-60, 13. [Sp.]

Rye and sorghum, especially black sorghum with millet as a useful addition, successfully stabilized in 18 months 80% of a dune covering 6 ha. Cultivation facilitated the spread of natural vegetation.

48. Meer, K. van der
1952. Reclamation of dune-sand soils.
Soil Sci. 74, 69-74.

The trenching or dredging involved in dune reclamation is very costly, but the excavation of a dry dune-sand soil leaves a moist calcareous soil excellent for bulbs, while the excavated sand raises the surface level of low lying heavy clays, producing soils excellent for market gardening. Soil conditions, methods used and the importance of ground-water level are discussed.

49. Messines, J.
1952. Sand-dune fixation and afforestation in Libya.
Unasylva 6, 50-58.

Natural vegetation and attempts to introduce drought-resistant plants are discussed. A climatic table compares several districts in Libya with others in Australia. Acacias and eucalypts are recommended, planted 150 plants per hectare and spaced 6 x 8 m. Of the eucalypts E. gomphocephala has already proved useful in Libya and 8 other species and 4 or 5 species of acacia are recommended. The extent to which afforestation is possible cannot be determined, but the uniform planting-up of whole areas should not be aimed at.

50. Mort, G. W.; Hewitt, B. R.
1952. Vegetation survey of the marine sand drifts of New South Wales. Part 2 (continued).
J. Soil Conserv. Serv. N.S.W. 8, 63-71.

Creeping groundsel (Senecio crassiflorus) has given good results in dune reclamation. Other promising species are sand dandelion (Arctotis stoechadifolia) pig face (Carpobrotus aequilaterus) and coastal guinea flower (Hibbertia volubilis).

51. Muhammad, K.
1952. A note on the afforestation of shifting sand dunes area in the Thal (desert) area of the Punjab.
Pakistan J. For. 2, 276-279.

Basin irrigation during the annual stormy period has been effective in levelling dunes and improving the sand by silt deposition. Where irrigation water is not available stabilization is successfully effected by planting Calligonum spp. and Calotropis procera. Suitable plants and trees for stabilising water courses are listed.