Form A

UNIVERSITY OF CALIFORNIA
DIVISION OF AGRICULTURAL SCIENCES
AGRICULTURAL EXPERIMENT STATION

PROJECT NO. 1686 PG. 1

Alan B. Carlton
Project Leader

Davis, Vegetable Crops
Campus and Department

DATE Oct 1, 1955

Title: Peat Land Conservation and Peat Dust Abatement

Personnel: Alan B. Carlton and cooperating research and extension staff

Location of work: Sacramento-San Joaquin Delta

University units co-operating: Agricultural Engineering, Agronomy, Extension Service Irrigation, Soils and Vegetable Crops.

Co-operation of other agencies: Growers
U. S. D. A., Industries, Growers, other Experiment Stations, etc.

Funds used: 1955 to 1957 City of Stockton, San Joaquin County and Growers Grant
1957- University of California
University, Federal, Grants, etc.

Probable duration: Indefinite

Research Advisory Committee: Roy Rainer, W. C. Fleming, H. B. Schultz, J. E. Knott, M. L. Peterson, G. C. Hanna, V. S. Osterli, D. G. Aldrich, D. W. Henderson, R. M. Hagen

Project Record

Suggested by: F. N. Briggs

Date suggested: Feb. 1955

Date begun: April 1, 1955

Date of last revision:

Date concluded:

Approval Signatures

Alan B. Carlton — Oct 4 1955
Project Leader — Date

J E Knott — Oct 7, 1955
Department Chairman — Date

F. N. Briggs — OCT 14 1955
Campus Assistant Director — Date

Paul F. Sharp — Oct 17, 1955
Director, Agric. Experiment Station — Date

Outline of the Investigation—On succeeding pages present an outline of the proposed project following the directions set forth on the reverse side of this form.

D-029584

D-029584

Form B-20m-9,'55(B1560)

UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

PROJECT NO. ..... PG. 2

REPORTED BY .....

Davis, Vegetable Crop
Campus and Department

DATE 10/1/55

I. Title: Peat Land Conservation and Peat Dust Abatement.

II. Objectives:

1. To develop methods of reducing the erosion of peat land by wind.
2. To determine the feasibility of (a) the culture of crops that will not expose dry peat to the action of wind, and (b) the production of livestock on irrigated pastures on peat lands of the Delta.
3. To determine the factors affecting the subsidence of peat land.
4. To determine the meteorological conditions that contribute to wind erosion of peat.
5. Determine the characteristics of various peat soils in relation to their susceptibility to blowing.

III. Reasons for undertaking the work:

The peat soils of the islands of the Delta when dry are very subject to wind erosion especially during May and June. Cultural practices as followed by most growers tend to destroy the soil aggregates thus contributing to their erodibility. The subsidence rate during the past if long continued can destroy these soils as an agricultural asset to the economy of the area and the state.

The citizens of Stockton are aroused by the clouds of peat dust that at times permeate the city because of the nuisance to their living and of the possible health hazard. The growers are concerned not only because of the pressure against them for maintaining a nuisance but also because of their growing realization that their valuable farms are gradually disappearing.

The results of the research should provide means for reducing the wind erosion, and possibly the subsidence of the lands; develop alternate farming systems that will be economically sound; and abate the dust problem in the City of Stockton.

IV. Previous work:

The rate of subsidence of the peat land has been under study by the Soils Department since 1922. The Agricultural Extension Service in San Joaquin County has been studying the adaptation of varieties of corn and other field crops, the development of irrigated pastures, the areas where the molybdenum content of forage would be toxic, and the feasibility of cattle production.

In other states the blowing of peat land has been studied, especially in regard to the prevention of injury to the crop being grown due to flying particles of peat. Since the expense of soil in these areas is very small in comparison to the open acreage in the Delta, the use of many windbreaks and snow fences has been effective. Interrow plantings of oats and barley have been successful in onions and lettuce for reducing the wind velocity close to the surface thereby protecting these crops.

V. Procedures:

A. The loss of peat by wind erosion will be studied by:

1. Testing of crops that might be used for interrow plantings in ridged asparagus, as to rapidity of growth, height and effectiveness in reducing the wind erosion for both cross-wind and down-wind row orientation.

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Campus and Department

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2. Determination of seeding rates, time of planting and time of removal of interrow planted crops, especially those where harvesting of a product is possible. Their probable effect on the asparagus must be determined also.

3. Measuring the effectiveness of presently existing wind-barriers of poplar and other trees.

4. Determining the effectiveness and economics of sprinkling to stabilize the surface of ridged beds in relation to the frequency and amounts of moisture applied.

5. Determining the effectiveness and economics of chemical stabilizers applied to ridged asparagus.

6. Determining the effectiveness of allowing asparagus ferns to develop in April on rows at intervals across a field to serve as a series of windbreaks.

7. Determining the effect of asparagus row direction in relation to wind direction on wind erosion.

8. Observing the relative loss of soil by wind erosion in corn, potatoes, harvested grain fields, etc. compared to asparagus.

9. Explore the use of chemicals for weed control and possible modifications in soil tillage practices as methods for preventing destruction of soil aggregates.

10. Developing modifications in equipment that will reduce the raising of dust into the air and reduce the pulverization of the soil.

11. The possibility of using certain non-spreading varieties of bamboo for use as windbreaks will be investigated.

B. Alternate crops for asparagus will be studied by making several types of experiments:

1. Blueberry production will be tested.
2. The adaptation of grasses and legumes for irrigated pastures will be evaluated; the proper management and the carrying capacity of such pastures on peat land will be observed; and the distribution of areas of molybdenum toxicity investigated.
3. The economic feasibility of Christmas trees as a plantation crop will be studied.

C. 1. The biological and other factors involved in the oxidation and subsidence of peat soil will be studied to give basic data that may lead to modifications in the management of the peat soils of the islands in order to preserve them.

D. 1. The meteorological conditions contributing to dust storms will be studied by establishing one or more automatic weather stations in the Delta.

2. A dust and smoke sampling machine will be installed in the City of Stockton to obtain a continuous record of the dust and smoke content of the air in the city.

3. Measurements of wind velocity and dust movement from fields will be made as often as the opportunities present themselves.

4. A study will be made of the wind velocity required to cause dust movement from various types of crops and open land.

5. Soil samples collected under various wind conditions will be analyzed to determine the relative percentages of peat and mineral soil in the air at those times.

E. 1. Basic characteristics of various peats will be studied to determine differences that contribute to their relative susceptibility of blowing.

The work will be done in grower's fields in the Delta except for those laboratory studies that will require the use of special facilities available at Davis. Instrumentation for the field studies will be provided from funds of the grant.

VI. Literature:

Kenner, F. M. Conservation of Michigan's Muck Soil. Mich. Agr. Ext. Bul. 307. 1951.

Gustafson, A. F. The control of wind erosion on muck lands. Cornell Agr. Ext. Bul. 482. 1942.

Albert, A. R. and Leamen, G. S. Farming muck and peat in Wisconsin. Wis. Agr. Ext. Cir. 456. 1953.

Weir, W. W. Subsidence of peat lands of the Sacramento-San Joaquin Delta, California. Hilgardia 20(3): 1950.

Form B-90m-9,'55(B1560)

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AGRICULTURAL EXPERIMENT STATION

PROJECT No. 1686 Pg. 7

REPORTED BY A. B. Carlton

Davis, Vegetable Crops
Campus and Department

DATE January 13, 1956

Peat Dust Abatement

Dust Storms - Twenty-seven dust storms from April to November inclusive were observed and recorded. They varied from severe and general to minor and localized. Not included in this category are many observations of dust blowing on the islands at times when there was no noticeable dust in the City of Stockton or its suburbs. Storms were caused by winds all the way from SW to NNW although the majority were associated with the usual prevailing W to NW winds. The storms appear to be spotty in both time and location and seem to change their pattern rather rapidly. The storms can occur at any time but are frequently associated with the mid and late afternoon hours. A fairly strong wind arising early in the morning generally results in a severe storm over a rather extended period of the day. Visibility varies between a few miles and a few hundred feet, depending on severity. Seldom is the entire city enveloped in a general dust storm. More frequently localized sections of the city, particularly the west central and northwest sections only may be hit in whole or in part. During the most severe storms dust appears to come from all barren, exposed soil surfaces, whether it be peat or mineral, including unplanted or newly planted land, bare asparagus fields, gravel roads and shoulders, and levee banks. During these storms, relatively little dust is brought into the air by the action of tractors and implements, due partly to the practice of many farmers of bringing their equipment in from the fields during high winds due to decreased visibility and hazardous working conditions, and partly to the relatively large amounts of dust brought into the air through natural processes of wind erosion. Because of the foregoing observations indicating a high degree of variability in wind direction, land from which dust arises, and the spottiness of dust within the

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city, it is difficult, at least at this time, to generalize on how much of the dust hitting Stockton arises in peat areas and which of the islands in the delta are most responsible for this dust.

Row Direction Observations - In early May, two different observations indicated that cross wind orientations of white asparagus beds were less susceptible to wind erosion than down wind orientations. These observations were well controlled in that they were made on adjacent fields which, as far as the eye could determine, were of the same soil characteristics and had been worked to the same degree of tilth and with the same bed shapes. Large quantities of dust could be seen arising from the down wind beds while little or no dust could be seen arising from the adjacent field with cross wind bed orientation.

Later that month, however, the opposite phenomenon was observed on another island. There was distinctly more dust arising from white asparagus beds which were cross wind. This apparent contradiction appears to be explained by the fact that the degree of tilth or surface dustiness is a large factor in wind erosion in addition to ground level wind velocity. When winds are high enough to cause general erosion, the cross wind beds are badly deformed or even moved laterally like sand dunes. This often necessitates more frequent tillage and bed reforming in the cross wind white asparagus. As a consequence, cross wind beds have a tendency to be drier, to have a finer tilth, and to more frequently have a virgin, dusty, surface with no erosion pavement.

Because of the added complication just cited, it is difficult to determine whether down wind or cross wind plantings of asparagus produce the most dust. Since the evidence for planting in one direction or another is not clean cut

and because of the large number of uncontrollable variables and factors, it is felt that no recommendations for row direction of new asparagus plantings for the purpose of dust control can be made at this time.

Cereal Cover Crop Variety Trials - On April 25, 1955, seven varieties of cereals and two varieties of legumes were planted in randomized, duplicated plots each 14 ft. by 30 ft. over ridged white asparagus on Rindge Tract. All varieties were drilled to moisture at the rate of 16 to 18 rows per two asparagus rows. The varieties were Onas 53 wheat, Ramona 50 wheat, Kaart 46 wheat, Merced rye, King rye, Atlas 46 barley, California Mariout barley, oat beans, and guar.

On April 29, 1955, similar plots were set out with Pidtoo winter barley and Kearney winter barley, both from Nebraska. There were no exact duplicate plots as half of them were drilled as before while the other half were broadcast at 150#/acre and raked in. Rain immediately followed both plantings. By May 4 cereals of the first planting were up and by May 10 all cereals were up 3"-5". No legumes ever came up. At this stage, the barleys appeared to give the best cover while the ryes produced the least. The stands of the sown barley were very spotty. At the 3"-5" stage a whirlwind was seen to traverse the plots and a very noticeable decrease in amount of dust picked up was observed. At this stage the cover crop plantings did not interfere with normal harvesting operatio

By May 23, all cereals were interfering with normal harvesting operations and by May 27 harvesting on the plots had virtually ceased. At that time the average height of the California varieties varied from 7" to 12" while the Nebraska winter barleys had stooled out heavily and averaged 6" high. On this

date a fairly energetic whirlwind traversed the plots. The dust burden of the whirlwind was estimated to have dropped to about 10% of its previous density as it crossed the cereal cover.

Although the cereals tried appeared to control wind erosion and consequent dust quite effectively, none of the varieties were sufficiently low-growing to permit asparagus harvesting after 3 to 4 weeks after planting.

Barley Interrow Planting Experiment - On about April 25, 1955, approximately 10 acres of ridged white asparagus in three plots were planted to barley between the asparagus beds in strips 24" to 30" wide. The plots were 10 rows wide and varied in length up to 0.4 miles. The barley was seeded by hand broadcasting from a tractor at about 50#/asparagus acre (200#/barley acre) and lightly harrowed in. Two of the plots were in rows running approximately NESW while one of the plots ran nearly NW-SE. By May 3, the barley was up 3" high in good stand. Twice in June, on the 9th and again on the 28th, these plots were observed under very windy conditions when the wind came from WSW to W at 20-25 MPH with gusts to 30 MPH. By June 9th, two of the three plots were up 8" to 18" and averaged 12". On both occasions these two plots were highly effective in holding down wind erosion and consequent dust to a relatively low figure, even though the wind was at a considerable angle to the rows (45°). As a consequence, the barley interplanted rows required only one re-ridging during the entire harvest season (primarily for weed control) while the remainder of the field required two. The third plot was completely ineffective in modifying or preventing wind erosion. The stand of barley was poor and much of which came up was only 6" high and the remainder no more than 10" to 12" high

There was apparently no windbreak action for lack of adequate barley stand and height. It was later learned that this latter plot was on quite acid soil (pH 4-5) and that perhaps a more acid tolerant cereal such as oats would have been better in such a location.

Of necessity, this barley was knocked down about June 30th at the end of the asparagus harvesting season when the beds were split open to allow the fern to grow. Mature barley seed had set by this time. These plots were observed early in September after the fields had been subjected to four cultivations and there was still sufficient barley stubble mulch left on the surface to materially modify any wind erosion which might take place due to winds directly parallel with the asparagus fern rows.

In early December the barley was found to have volunteered in good stand with some rather tall clumps which had sprung from unshattered whole heads after the first fall rains. It is not known at this time however of a problem this volunteer barley will create.

It was generally agreed by all who saw these plots during the spring that the interplanting of white asparagus beds to some tall, quick growing, non weedy plant or crop holds considerable promise. Because of the necessity, in about mid-April, of bringing soil from between the asparagus rows to form the high beds needed to produce white asparagus, it is realized that in most instances the planting of the inter-row crops cannot be done prior to the conversion from green market to white asparagus. As a consequence, it is planned to vastly expand the acreage and number of cooperators during the coming season to learn more about the application and adaptation of this practice to the varied soil and farm management problems existing in the asparagus industry

in the Delta as well as well as to find the plants most suitable for interplanting.

Fern Growth Experiment - It had been suggested that asparagus fern might act as its own windbreak during the white asparagus harvesting season and thus diminish the dust blown from these fields. Two plots were established on peat soil which is normally very subject to wind erosion on May 14, 1955, by opening the beds and ceasing harvest on certain asparagus rows. In one plot, every 9th asparagus row was allowed to go to fern and consisted of 8 such fern rows. The rows had a N-S orientation. The other plot had an E-W orientation of 5 fern rows spaced at every 5th asparagus row. Within two weeks the fern on these plots was up 2'-3' high but the stand on the plot with 5th row spacing was only poor to moderate. These plots were observed in high winds (of the order of 20-2 mph) several times after they had been in fern at least two and one-half weeks. The spacing of asparagus fern rows every 9th asparagus row (62½' in this case) appears to have little if any usefulness in controlling wind erosion. No difference in dust seen rising from the plot as against the remainder of the field was discernible. The failure of this plot to control dust is probably attributed to a combination of the following factors. The spacing was too great for the relatively low fern height and the ferns themselves were insufficiently dense, particularly in their lower parts. The usefulness of the plot with 5th row spacing was more difficult to assess because of its poor to moderate stand and the fact that it was not cultivated for a long period after the spring rains, allowing the resulting crusting and weeds to exert a considerable but undeterminable effect in holding down the dust. It was felt, however during one of the observations that the 5th row spacing of fern

appeared to be of more benefit. From the meager results of these two plots it is felt that the use of asparagus fern as natural windbreaks is probably not economical because at least 20% of the crop acreage must be let go in order to effect at best only partial control. Closer fern row spacing would undoubtedly give better dust control but would probably become prohibitively expensive in terms of yield loss.

A third fern growth plot was established on soil which does not normally blow and was to be used for wind reduction studies by means of integrating recording anemometers. The stand turned out to be poor and only of low height (1' - 3') and could not be used.

In November, just prior to the dropping of fern, no difference in size could be noticed between the asparagus rows which had been harvested the full season and those which had been allowed to go to fern early in May. Those which had been allowed to go to fern early, however, appeared to be more mature, that is, yellower, than the rest.

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REPORTED BY A. A. Carlton

Davis, Vegetable Crops
Campus and Department

DATE January 13, 1956

Chemical Stabilizer Experiments

It had been suggested that one possible solution to the wind erosion problem in the Delta might be the spraying of some dust palliative on the bare soil surface. Accordingly, two different types of commercial palliatives were tried, a lignin-sugar by-product of paper making and an asphalt emulsion.

Orzan 503-S- Orzan is a water soluble lignin-sugar complex produced by Crown Zellerbach Corporation. Orzan 503-S is an oil emulsion formulation consisting of 25% Orzan, 50% #3 road oil and 25% water. It was used in these studies because of its resistance to leaching by rains. Two different treatments were applied to ridged white asparagus beds, one late in May and the other early in June. The first consisted of a plot 8' x 1100' treated at the rate of 1000 lbs. Orzan 503-S per acre. The 503-S was diluted with 5 times as much water and Joy and Tide were added as wetting agents. A small Jean agricultural high pressure spray rig was used to apply the solution. The second plot was 8' x 220' and was treated with 503-S at 1000# per acre as before but this time was diluted with 10 times as much water (twice the dilution of the first plot.) Orzite NT-W dispersant at 0.1% was used instead of Joy and Tide and the treatment was applied in one swep with a 3-nozzle hand boom wood sprayer.

The effect of the first treatment was superficial but in the second treatment, the penetration was good (1/16" - 1/8") and the surface became thoroughly wetted and saturated. One week after the first treatment, no surface crust could be found but the top of the bed seemed to be somewhat stabilized (aggregated) although the sides of the bed showed no effect of treatment. This was perhaps due to the design of the spray rig and nozzles. It was for this reason that a hand boom was used for the second plot. The second plot was observed two weeks after it was established and only 5% to 10% of the treatment

remained and all of this was on the top of the bed where little erosion occurs. At this time (five weeks after the first treatment was established) all of the first treatment was completely gone.

Bitumuls SS-1. Bitumuls SS-1 is an asphalt emulsion with enough emulsifier to allow it to be diluted considerably with water. It is produced by the American Bitumuls and Asphalt Company of Oakland, California. Two treatments of Bitumuls were applied to ridged white asparagus beds in mid-June, each at the rate of 1000 lbs. of Bitumuls SS-1 per acre. The Bitumuls was diluted 20-1 with water for the first treatment and 5-1 with water and Cronite NL-W dispersant (at 0.1%) for the second. The material was sprayed on in one pass with a 3-nozzle hand wand boom at about 200 PSI. The emulsion of the first treatment partially broke down in the equipment causing a considerable amount of trouble with asphalt in the screens and tank.

One day after application both treatments looked good; there was a considerable crust on both plots but asparagus emerged easily. However, the crust was already being destroyed by the normal asparagus cutting operations. One week after application both treatments had nearly disappeared, there being perhaps no more than 10% left on the windward side of the 5-1 treatment and even less on the 20-1 trial. There was about 50% of the 5-1 treatment remaining on the top of the bed but this was ineffective in erosion control. Detection of the amount of treatment left on the leeward side was difficult because it was covered with wind-blown soil.

CONCLUSION. The use of chemical stabilizers or dust palliatives of the nature of those tried seems impractical from a number of points of view. Both materials tried cost in the order of $30 a ton delivered in Stockton. This would amount to not less than $15 per acre for material only. Another factor is the excessively large amount of

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water which must be hauled into the field and sprayed. The lowest rate of dilution in any of the experiments tried would require 800 gallons per acre and even the largest tank truck would have to be refilled every few acres even if it were possible to pull it through asparagus fields on peat land. The last and perhaps most important factor is the short life of the treatments. This short life is due primarily to the breaking down of the surface crust by the action of the cutters' knives and feet although wind erosion probably also is a factor after the crust or aggregated layer is partially broken up. Another problem also comes up. After five or six weeks, the first plot to be established became very weedy to the detriment of the asparagus harvest. Should any form of chemical stabilizer treatment prove effective, ways must be found to control weed growth without disturbing the rather costly dust control treatment.

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Dust Collecting Activities

Several types of dust collecting equipment were tried for the purpose of estimating magnitudes of dust storms in the city and for evaluating experiments in the field.

Research Appliance Corp. Automatic Dust and Smoke Sampler. This piece of equipment was obtained for the purpose of monitoring dust storms in Stockton and to establish possible correlation between magnitude of dust storms (at least in a certain part of the city) and the weather factors wind direction, wind velocity and air temperature as measured by the recording weather station. The sampler consists essentially of a small diaphrem vacuum pump pulling air at about two cubic feet per minute through a filter paper strip. The strip is moved periodically (a two hour sampling interval was found to be best) by a timer motor to allow for a new sample to be taken. Evaluation is by photometric density measurements of the dust spots. After a shakedown period of operation indoors it was found that a cover would be necessary for the front of the sampler to prevent the filter paper strip from becoming contaminated with dust. This modification was made and the sampler installed on July 19th on the roof of a cooperator living in a particularly dusty suburb of Stockton.

From this time until it was taken down because of threatening fall rains no major dust storms occurred. Because of this, no conclusion can be drawn relative to dust storm magnitude and weather. An important observation was made, however. Frequently rather dark spots showed up on the tape, particularly in the morning hours, at times when there certainly was no dust storm and probably very little dust in the air. This is attributed to smoke in the air. (Smoke has a very high staining ability.) It remains to be seen whether most dust spots can be differentiated from smoke spots in such a way that the sampler might be a reasonably reliable detector of dust storms.

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Bausch and Lomb Impinger. A Bausch and Lomb self-contained impinger type of dust collector was tried under field conditions during a dust storm. This collector impinges the dust from a few cubic inches of air sample onto a glass plate where dust particles are counted by means of a dark field microscope. The very small sampling volume and the great variation of dust with time and location combined to give very large standard deviations with six to twelve replications. Comparison of dust from fields with two different treatments became impossible although the eye could easily detect a considerable difference. It was concluded that any such small volume sampler was of no value for the purpose of evaluating dust magnitude in the field. Rather, a sampler that collected air over a considerable period of time was necessary to integrate the heterogeneity of dust coming from fields.

Staplex and Continuous Flow Impinger Samplers. After an extensive review of literature and dust sampling equipment available, it was decided to experiment with two types of apparatus: (1) an impinger type involving the pulling of a dust sample into a known volume of water; and (2) a vacuum type apparatus which collects the dust sample on a filter paper which is weighed.

One of each type of sampler was tried in the Stockton area using a mounted aircraft engine with propeller attached to generate wind of sufficient velocity to produce visible dust. The vacuum type, a Staplex sampler proved to be a very efficient sampler capable of collecting a large sample in a very short period of time. Conventional filter paper traps permitted a sampling rate of 20 cubic feet per minute but the sample was very difficult to control once the power source was disconnected. A pleated filter type TFA "S" manufactured by Staplex permitted a sampling rate of

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67 cubic feet per minute with the added advantage of the dust sample being trapped in the pleats of the filter thus permitting the sampler being disconnected without losing the sample.

The Impinger sample, operating at a capacity of 1 cubic foot per minute proved to be satisfactory for long time sampling over periods of several hours and for separation of mineral matter from the dust.

On the above basis two Steplex samples and two Impinger samplers were purchased.

On the 16th of October, a Steplex sampler was taken to the portable weather station, Sec. 15 on Ringe Island. A fifteen minute run using conventional filter paper at 20 cubic feet per minute revealed dust was present in the air at an integrated wind velocity of 10 miles per hour, without being visible to the eye. With this low amount of dust present, 2 samples, using TFA Type "S" filters at 67 cubic feet per minute, were taken over 1/2 hour intervals. The integrated velocity of the wind during this time was 10.6 miles per hour. Attempts to weigh the TFA Type "S" filter before and after sampling were unsatisfactory due to the drying effect of the large volume of air passing through them. However, the samples were transferred to watch glasses and weighed.

Sampling time	Integrated wind velocity mph.	Dust mgms.	Total volume air, cubic ft.
30 min.	10.6	48	2010
30 min.	10.6	51	2010

With this small sample, a detailed analysis was not possible but examination with a binocular microscope revealed that approximately as much mineral matter was involved as organic matter.

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On the basis of the above information, it is anticipated that correlations between wind velocities and amounts of dust in the air can be made satisfactorily, and appropriate measurements of dust removal from variously treated plots are planned.

Study of Correlation of Water Table Depth With Tendency Toward Dustiness. Some fields or spots within a field seem to tend to be more subject to wind erosion than others. Several such locations were chosen and depth to water table was measured. There was relatively little difference in depth to water table among the locations and no correlation at all with tendency toward dustiness.

D-029603

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Davis, Vegetable Crops

January 16, 1956

Agricultural Extension Service Projects - The Extension Service in San Joaquin County is primarily responsible for a number of projects incorporated into the Peat Land Conservation program. Briefly these are as follows.

Christmas Tree Variety Trials - About 200 trees representing seven species were planted on typical peat soil in the Delta. By the end of the year survival had been good to excellent on four of the seven species and good growth had taken place. The purpose is to determine what trees, if any, might be suitable for Christmas tree plantations and/or wind breaks in Delta soils.

Irrigated Pasture - An 18 acre pasture was established on peat and stocked with 60 head of young steers. The purpose of this experiment is to re-investigate the feasibility of raising cattle on irrigated pasture on peat soils and to determine its ability to compete economically with present crops. The cattle appeared to thrive although the pasture was still quite weedy and the legumes had not been established fully. Copper was fed in the drinking water to combat any tendencies toward molybdenosis and winter supplemental feeding of grain cleanings was begun.

Blueberries - Blueberries as a possible new crop for the Delta peat soils was under study and a cooperator lined up for trial plantings. Soil and water samples were taken for analysis.

Weed Control - In cooperation with representatives of American Cyanamid, several weed control plots were put out in asparagus with new and experimental herbicides (amino triazole and E H 6249). Weeds treated were Bermuda grass, Johnson grass, and nutgrass. Weed control in white asparagus (little has been done in this field) is an important facet in the problem of controlling peat

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January 16, 1956

dust and wind erosion. Much of the cultivation currently practiced in white asparagus farming during the spring harvesting season is for weed control. Each cultivation breaks down the erosion pavement formed by the winds, further dries the bed out, and brings to the surface a fresh and highly dusty lot of soil. Any decrease in the number of cultivations required would decrease the susceptibility of the soil to wind erosion.

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D.W. Henderson

Davis, Irrigation

January 16, 1956

Sprinkling and Wind Erosion of Peat Soil

Mr. Al Zuckerman operated a mobile sprinkling unit on Mandeville Island in order to determine the effectiveness of sprinkling in reducing wind erosion of peat.

Operation of this unit was observed on several occasions, with two primary objectives:

(1) To determine the feasibility of maintaining a high enough moisture content in the surface soil of asparagus beds to reduce wind erosion.

(2) To find out whether sprinkling would cause sufficient compaction and/or crusting of loose surface soil of reworked asparagus beds to be effective in reducing wind erosion.

Observations indicated that sprinkling was effective in increasing the moisture content of surface soil only for a relatively short period. Data collected showed that the moisture content of soil of the surface 1/2 inch of beds sprinkled on June 7 was rapidly reduced by evaporation, and was no higher than that of unsprinkled beds by June 13. Later in the season when insufficient water was applied to rewet all the dry surface soil, the moisture content of the surface soil dropped more rapidly. It was concluded that it would not be feasible to sprinkle often enough to retain sufficient moisture in the surface soil to be effective in reducing wind erosion materially.

However, some consolidation of loose, recently worked asparagus beds occurred. Mr. Zuckerman felt that this effect would be sufficient to materially reduce soil movement in storms of high wind velocity and long

duration-i.e., storms which would completely destroy loose, dry beds. However, no storms of such intensity occurred, and this observation could not be tested.

Wetting of the beds by rainfall or sprinkling resulted in the formation of a very thin light crust. Observations indicated that the crust was effective in preventing movement of soil at low wind velocities, but there was no adequate means of obtaining quantitative data for evaluating the effectiveness of the crust. It was judged not to be sufficiently durable to prevent movement at high wind velocities. Furthermore, it was easily destroyed by trampling and insertion of cutting knives during harvesting operations. Crusting is therefore effective only for a short time after sprinkling, with the harvesting procedures used. Much of its effectiveness was gone after one week, and the crust was almost completely gone in a period of two weeks.

Sprinkling can thus be expected to reduce wind erosion markedly only for a period of a few days after irrigation for storms of low to moderate wind velocities which would be expected to remove only a thin layer of soil from the surface of the bed. The effect may be much more lasting for severe storms, because of consolidation of the beds.

Keeping crusts more intact for longer periods may be possible by modifying harvest practice to reduce trampling of the beds. Whether or not this is economically feasible is not known.

Much of future work on the problem will be directed toward the finding the most effective application of water for minimum cost. This will involve amounts of water to apply, frequency of irrigation, and rates of application.

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UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

PROJECT NO. 1686 PG. 25

REPORTED BY H. B. Schultz

Davis
Campus and Department

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PEAT LAND CONSERVATION PROJECT
Contribution of Ag. Eng. - Weather Climatology

Personnel: H. B. Schultz

A spot climate station of the Agricultural Engineering department was installed on May 20, 1955, on Rindge Island. This location was considered desirable as most of the experimental work of this project was started on this island, e.g., an irrigated pasture, a christmas tree nursery (to study their suitability for windbreaks), and several field crop plantings. The location is 5 miles west northwest of Stockton which is about the direction of the most frequent strong winds blamed for carrying the peat dust into the city and therefore excellent for obtaining continuous wind-recording. After calibration of the Friez-anemometer (model 339-A), which is operating at a height of two meters, the wind records were evaluated till September 30, 1955. The monthly frequency distribution of days with strong winds shows high values for the months of May and June, and fast decline thereafter, see following table 1.

Table 1
Number of days with at least one hourly velocity of 10 mph or more

	May	June	July	Aug.	Sept.	Total
Number of recorded days	12	30	29	29	27	127
No. of days having vel. 10 mph or more	11	29	19	6	11	76
No. of days vel. 10 mph from west	8	25	18	6	10	67

The third line in table 1 reveals that the prevailing direction of the strong winds is west. Often there is a slight north component recorded, however not strong enough to tabulate this flow as WNW-wind. Table 2 shows the direction distribution for all 76 days with periods of strong winds.

Table 2

Frequency of directions for velocities of 10 mph or more from May 20 to Sept. 30, 1955

Directions:	S	SSW	SW	WSW	W	WNW	NW	NNW	N
No. of days:	0	0	1	4	67	1	2	1	0

The prevalence of the west directions for the high velocities shows a similarity to the general flow pattern for the summer, figure 1. The general isobaric situation generates NW-winds, as observed at coastal stations. At inland stations the directions are deflected according to orographic conditions, and also due to temporary overheating in the Central Valley which causes a particular anomaly in its northern part, now under study in connection with the Agricultural Engineering project: Use of Aircraft in Agriculture.

The strong maximum of high velocities* as shown in table 1 is still more pronounced when the frequency of hours of strong winds is compiled as is done in table 3.

Table 3

Totals of hours of high velocities for the various months
(The figures for May are extrapolated to 31 days)

	May	June	July	Aug.	Sept.
No. of hours of 10 or more mph	(270)	242	94	12	47
No. of hours of 15 or more mph	(85)	87	10	0	1
Ave. duration of one daily period of winds of 10 mph or more	(10)	8.4	5	2	4.3 hours

According to this table the month of August shows extremely low values, and when in table 1 the August still showed 6 days with strong winds, those were of short duration as can be seen in the third line of table 3.

* May and June

(The average duration of 2 hours in August was obtained by dividing the number of hours (12) in table 3 by the number of days (6) in table 1.

Table 4, the hourly distribution, shows that during the whole season the velocity never reached 10 mph from 3 to 5 in the morning, and never reached 15 mph during most of the night hours. The most hazardous time appears to be from 2 to 6 in the afternoon.

The critical velocities of 10 and 15 mph were chosen arbitrarily. Perhaps a velocity of 10 mph is not hazardous under most soil conditions, but this low threshold value had the advantage of getting a greater number of data to work with. This was desirable, as one year's record is too little for proper evaluation. Also due to the installation in May, no information was obtained for March and April.

Table 4

Frequency of velocities of 10 and more mph for the various hours of the day, May till September

PST	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
AM	2	1	2	0	0	1	8	11	19	26	24	29
PM	31	41	50	60	59	48	37	14	9	5	2	3
same for velocities of 15 and more mph												
AM	1	0	0	0	0	0	3	2	5	3	7	7
PM	7	7	13	17	24	22	6	3	1	1	0	0

Anemometer Calibration

As measurements of vertical wind profiles and of velocities behind wind breaks are planned the main requirements are anemometers constantly kept under calibration, so that velocities could be determined accurately

in tenth of miles. A calibration program for 12 Fries 339-A anemometers was carried out by operating under open air conditions. This method also is preferred by the Seabrook Climatological Laboratory to the wind tunnel calibration, as the normal wind structure never can be simulated in a tunnel. Also, in the open air method, 6 anemometers could be handled at a time thus giving the opportunity of direct comparison. They were mounted on a bar built in the Agricultural Engineering Research Laboratory, see figure 2. As receiver served the new Bristol operation recorder. During these tests several adjustments had to be made at this recorder, and it took some time to get acquainted with this low-priced apparatus and to locate the places where failure during field tests could happen. All anemometers were calibrated for the range from 1 to 17 mph and calibration curves drawn for each. The equipment is ready for field tests which can be carried out as soon as interplanting between the asparagus rows start growing.

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General Conclusions of 1955 Work. Briefly listed below are the findings of general observations and conclusions of those experiments which were completed during the year.

Dust storms are highly variable from one to another and very heterogeneous in nature in both space and time. Most of them occurred in May and June during the white asparagus season. These are also said to be the two windiest months of the year. The wind directions associated with most of the storms varied from W to NW. The usual minimum average wind velocity (measured at 60' on the islands) associated with dust storms was about 15 MPH although average wind velocities as low as 11 MPH were seen to create considerable dust. Gustiness and ground conditions are important factors in this respect. Frequently ground which had just been reworked was seen to blow heavily while nearby ground, unworked for several weeks, was stable against the same wind.

Theoretically, asparagus beds oriented across the wind should be less subject to erosion than downwind beds. This was borne out in observations on nearly identical fields but the conclusion is nullified by the different cultural practices required of the two orientations. Because of the complexity of factors no recommendation of row direction for the purpose of dust control can be made at this time.

Cereal cover crops over asparagus beds materially reduced wind erosion but interfered with asparagus harvest to the extent that they are of no value in wind erosion control in asparagus.

Barley planted between the rows, however, when in good stand shows much promise in combating wind erosion. A vastly expanded scale of experimentation is planned for next year to study the problems involved in different types

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of management and cultural practices, soil types, moisture problems, and plants most suited for the purpose

Periodic rows of asparagus let go to fern early in the season to act as a natural windbreak holds little promise of being successful because of the relatively large portion of planted acreage which must be lost. When 20% of the field (every 5th row) was allowed to go to fern, only a small, if any, control resulted.

Two kinds of chemical stabilizers (dust palliatives) were tried without success. Their relatively high cost ($15 per acre for material alone) and very short effective life on asparagus beds (90% of effectiveness lost in one week) are the main factors.

Several types of dust measuring devices were tried for the purpose of monitoring dust storms and evaluating field experiments. Three types have been accepted as satisfactory for the studies and although no useful data was obtained this year, the equipment is ready for evaluation work in the coming spring season.

The sprinkling of peat soil with water forms a crust which, although dry, has considerable resistance to wind erosion. Preliminary experiments this year were begun with a self contained, single nozzle, high volume sprinkler which covered 2 to 3 acres at a setting. The sprinkler was built and operated by an interested cooperator. Observations indicated a considerable lessening of wind erosion and dust on fields sprinkled every two weeks. Complete cost figures are not yet available but it appears that sprinkling may be within the realm of economic feasibility.

Laboratory oxidation studies on peat soil samples from the Delta show

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an oxidation rate far lower than the subsidence rate of the islands. Whether the balance can be attributed to dust loss by wind erosion is not known.

No correlation could be found between depth ~~of~~ to water table and tendency toward dustiness.

Records of the weather station indicated that most of the higher velocity winds during the spring months were of a W or WSW direction. The station records also indicated much lower night temperatures on the islands during the fall than were reported for Stockton in the paper.

The Extension Service is cooperating in the project through several experiments in the Delta aimed at finding possible new crops which can economically compete with some of the more dust forming crops grown today. On the Extension Service program are also some weed control experiments in asparagus fields with new and experimental herbicides.