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Dust Storms

Observations of peat dust storms were made throughout the calendar year 1957. The first recorded storm occurred on April 1, 1957, while the last one of the year was on November 21, 1957. Forty-one storms were recorded altogether. They varied from mild and localized to severe and general. Included in this number were five storms caused by northerly winds and which by-passed Stockton and Lodi, and three caused by southerly or southeasterly winds which by-passed all cities in San Joaquin County and probably were unnoticed in other cities to the north.

As in 1956, storms were given a relative rating according to severity and placed in one of the five following categories: very severe, severe, moderate, mild, very mild. The statements on pp. 35 and 36 of the 1956 report relative to definitions and changing standards from one year to another are fully applicable to this report. Although more westerly dust storms hitting Stockton and/or Lodi were recorded in 1957 than in either 1955 or 1956, it is the general consensus locally that 1957 was less dusty than either 1955 or 1956. It should be noted that there were no very severe storms in 1957. The following tabulations include the data for 1955 and 1956 for comparative purposes.

Westerly dust storms hitting Stockton and/or Lodi:

Number of storms by month

	1955	1956	1957
January	(no data)	0	0
February	(no data)	0	0
March	(no data)	2	0
April	3	2	3
May	6	9	8
June	11	9	10
July	3	3	4
August	0	6	6
September	3	0	2
October	1	0	0
November	0	0	0
December	0	0	0
Total	27	31	33

Number of storms by half-months for May and June

		1955	1956	1957
May	1-15	1	1	4
May	16-31	5	8	4
June	1-15	5	7	9
June	16-30	6	2	1

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Talley of Storms by severity:

	Number of storms by severity		
	1955	1956	1957
Very severe	4	2	0
Severe		2	3
Moderate	8	6	5
Mild	15	14	14
Very mild		7	11

Severity by months:

Number of storms

		Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Very severe	1955								
	1956			1	1				
	1957								
Severe	1955		1		3				
	1956			1	1				
	1957				2		1		
Moderate	1955		2	1	4	1			
	1956				4	1	1		
	1957		2	1	1		1		
Mild	1955			5	4	2		3	1
	1956	2	1	4	2	2	3		
	1957			5	4	3	1	1	
Very mild	1955								
	1956		1	3	1		2		
	1957		1	2	3	1	3	1	

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Northerly dust storms generally by-passing Stockton and Lodi:

There were 5 storms in this category for 1957.

Dates:

Storm category	1955	1956	1957
Severe	4/4, 11/11	3/11, 12/21	4/2
Moderate	5/31	2/16, 3/27	4/1, 11/21
Mild			
Very mild			4/3, 4/25

Southerly or southeasterly storms missing San Joaquin County Cities:

Dates:

Storm category	1957
Mild	5/8
Very mild	4/17, 9/26

The 1955, 1956, and 1957 statistics for the westerly storms were reduced to percentages in order to better show the distribution of dust storms during the year. Despite the fact that the standard of dust storm evaluation no doubt changed somewhat from one year to the next as explained above, the distribution of storms was so strikingly similar that it was deemed justifiable to combine the data and calculate the yearly average distribution. It should be noted that this average distribution varies very little from the distribution of any individual year. Distribution by groups of months and distribution of the moderate and severe storms are also shown.

Distribution statistics (westerly storms)

Per cent of storms (all categories) in each month:

	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
1955	0	11	22	41	11	0	11	4
1956	6	7	29	29	10	19	0	0
1957	0	9	24	30	12	18	7	0
3-year ave.	2	9	25	33	11	13	6	1

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Per cent of storms (all catagories) by monthly groups (3-year average):

Monthly grouping	% of total dust storms
March and April	11
May and June	58
July, Aug., Sept., Oct.	31
May 16-June 30	52

Per cent of moderate and severe (and very severe) storms in each month (3-year average):

April	May	June	July	Aug.
17	13	53	7	10

May 16-June 30 - 67%

A number of interesting points are brought out in the above statistics as to the time distribution of dust storms which have a direct bearing on the methods for minimizing wind erosion and dust storms:

1) Practices for wind erosion control in early spring should be designed to combat northerly winds.

2) Practices for wind erosion control in late spring and early summer should combat generally westerly winds. (These westerly storms were caused, at different times, by winds from SW to WNW).

3) There has been a moderate or severe storm (from the north, not hitting Stockton or Lodi) every year for the past three years in the very late fall or early winter.

4) There were relatively few dust storms after August.

5) More westerly storms occurred in May and June than in all other months combined. Since the last half of May was considerably more dusty than the first half, over 50% of all the storms hitting Stockton and/or Lodi occurred during the 6-week period from May 16 to June 30. Furthermore, 2/3 of all the moderate and severe (and very severe) occurred during this same 6-weeks period.

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Dust Collecting Activities

On May 23, 1957, the Research Appliance Corporation Automatic Dust and Smoke Sampler was put into operation on the roof of a cooperator's home at 2647 West Euclid, Stockton. This is one block west of the location for the two previous years. The change was necessitated by the moving away of the original cooperator. The sampler was operated continuously except for minor interruptions until December 17, 1957. Optical density measurements of the paper tape spots have not been completed and tabulated.

Very little evaluation of inter-row planting by dust collection was done, due partly to the nature of the storms (they were not anticipated far enough in advance to get the collectors out) and the lack of adequate controls adjacent to successful inter-row plantings. The dust collection evaluation which was done was accomplished with vertical can collectors containing spiral baffles (see p. 40 of 1956 report) and is described under the section on Inter-Row Planting.

Inter-Row Planting Experiments

The 1956 series of experiments shed considerable light on the questions posed on page 41 of the 1956 report. One year's experience, however, was insufficient to adequately clarify many of them and, as was to be expected, it raised some new ones: How can inter-row planting best be used to protect both green and white asparagus? How can the winter volunteering problem be minimized? How great is the fire hazard from early planted inter-row? How does the inter-row planting work to minimize wind erosion and consequent dust? It was felt that a program similar to the 1956 program, but expanded to a larger acreage and larger number of growers, would give the best chance of clarifying the many questions. To this end, a meeting for asparagus growers was held on January 29, 1957. It was held jointly with the Agricultural Extension Service and, among other things, explained the University's program and experiences with inter-row planting. As a result, ten growers cooperated in the program for a total of 1,856 interplanted acres during the 1957 season.

Three distinct kinds of experiments were done on inter-row planting this year and they will be taken up separately. Briefly described they are: (1) regular field inter-row plantings planted early in the season for control of damage to greenmarket asparagus due to wind erosion (crook control); (2) variety-time of planting plots to determine growth habits with different planting dates and earliest planting dates giving rise to minimum fire hazard and volunteer problems; (3) field sized inter-row planting experiments in ridged white asparagus.

Early inter-row planting for crook control. Although the use of inter-row planting for the purpose of protecting greenmarket asparagus against crooks due to wind erosion was inconclusive in 1956, there was some evidence to indicate that it might be quite effective. Early inter-row plantings in 1957 of two cooperators were watched closely, particularly after wind storms. The results were again inconclusive due primarily to the high degree of weediness of the fields. The weeds tended to give the control or non-interplanted fields a considerable amount of protection. Weeds, however, cannot be relied upon for

protection as they are so variable from year to year. On two separate occasions (where the row directions were essentially perpendicular to the winds) crook counts were made. In each case there were several times more "crooked" spears in the control than interplanted plots but they were not sufficiently crooked to be classed as culls.

Other difficulties also arise from early interplanting. The workers complained about getting wet from the dew collected on the barley. One grower overcame this problem by issuing water-proof rain pants. One grower with 7½' beds found it impossible to ridge for white asparagus without destroying the barley. Much of the resulting chaff became worked into the ridged beds and the harvesting crew complained that it interfered with cutting for a considerable time afterward.

It still appears that if some of the management problems can be solved, inter-row planting might have considerable "insurance" benefit since large losses are sustained from crooks when the proper soil and wind conditions combine to cause severe wind erosion in the early spring months.

Variety-time of planting observation plots. One of the reasons for the difficulty in determining the proper time for planting inter-row protection has been lack of information as to how fast and how tall various cereals would grow when planted at different times. It has also not been known at what date the cereals would reach sufficient maturity to germinate or when they would become dry enough to be a fire hazard. Lack of germinating ability by June 30 would solve the winter volunteering problem. Three varieties were observed under different dates of planting ranging from March 26 to May 15. California Mariout barley was one of the varieties tried because it has been used extensively in inter-row planting and appears to be fairly suitable. Atsel barley was tried because it has lost its photo-periodic response and it was felt that it might grow taller than California Mariout barley when planted fairly late in the season. Oats appear to have their place in inter-row planting because some of the soils are too acid to obtain good barley growth. The Bannock variety from Idaho was chosen because of its tall growing characteristic. A nearby Extension Service plot of soft and Durum wheat was also observed.

Atsel barley. Atsel was planted weekly from March 26 to May 15 inclusive. By June 27 all plantings were 24"-27" tall. This compares with 24"-36" for California Mariout planted May 15. California Mariout planted in February and March normally grows to 36". Besides having no advantage in height, Atsel tended to be spindly and sparse and tended to dry earlier than California Mariout planted at the same time.

California Mariout barley. California Mariout was planted weekly from April 17 to May 15 inclusive. Planted as late as May 8, it reached a height of 25"-28" by the end of June. On June 27 this variety planted April 17 was not considered a fire hazard since 50% of the stalks, 10% of the heads and 5%-10% of the leaves were still at least partly green. The mid-April planting had a sizeable germination rate (50% or greater) from June 13 on while the April 24 planting had a greater than 50% germination rate by June 21. The May 1 planting had a germination rate of 80% on June 27.

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Bannock oats. Bannock was planted weekly from April 3 to May 15 inclusive. Planted as late as May 8, it reached a height of 30" by June 27 while the maximum height on June 27 was reached by the April 17 planting. For any given planting date, Bannock was about one week behind California Mariout in growth until about mid-June when the oats caught up with and surpassed the barley. By June 27, April planted oats were 6"-10" taller than barley planted at the same time. At any given date, barley planted in April was about the same height as oats planted two weeks earlier. By May 15, mid-April planted Bannock and California Mariout were 10½" and 14" high respectively. These heights are both great enough to offer a considerable amount of protection at the beginning of the particularly dusty six weeks period from mid-May to the end of June. Germination counts from various harvest dates indicate that Bannock oats should give little or no winter volunteering problem. The germination of oats planted on April 24 and harvested on June 27 was nil while those planted on April 17 was only 13%. Bannock planted as early as April 3 had only a 33% germination rate when harvested at the end of June. All germination rates were run after a resting period of more than five months. It was noted that many of the seedlings of low germination rate lots (less than 50% germination) were rather weak and would probably not survive the rigors of winter volunteering. The long growing season of Bannock oats makes them highly satisfactory from a fire hazard standpoint. By June 27, the oats planted on April 3 were still mostly green - considerably greener than California Mariout barley planted two weeks later. The growth habit of Bannock compared favorably with California Mariout barley an d was far better than many oats. The Bannock was as leafy as the barley and was generally very stiff and upright.

Durum wheats. The durums, Sentry and Nugget, in the Extension Service wheat plot showed some promise for inter-row planting material. They were particularly tall growing, at least when planted early, growing to a height of 28" by May 15 when planted in mid-March and obtaining an ultimate height of 38" by the end of June. By June 27, all the leaves were dry but 15%-20% of the stalks and heads very still partly green. They were judged not a fire hazard at that time.

<u>Field scale inter-row planting.</u> As in 1956, the 1957 inter-row planting program was affected to a considerable degree by the vagaries of market and weather. The marketing side of the 1957 asparagus season was most peculiar and unusual in that although the fresh market "broke" very early (about April 1) and prices dropped to an all time low, conversion to white did not take place until late and then over a long period. The canneries did not open until late and there was much anxiety among many growers as to whether they were going to find a canning outlet for their 'gras. Dates of conversion to white for inter-row planting cooperators varied from April 9 to May 28 with most of them converting from April 15 to May 15. Coupled with the late conversion and consequent late inter-row planting by many cooperators was a very early end of season date which, for most growers, was June 11. Normal end of season is June 25-June 30. Further complicating inter-row evaluation was an unseasonal heavy 3-day rain on May 18-20. This kept the fields non-dusty for a moderate period and effectively prevented the calibration of a new set of car-type dust collectors which is done under normal field conditions during dust storms.

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A list of plantings follows:

Island	Acres	Row Spacing	Grain	How Planted	Date Planted	Effective
Bacon	125	8'	Calif. Mariout	Drilled - 3 rows	3/20-24	Yes
Bacon	100	8'	barley	Drilled, alternate pairs of 'grae rows	3/15	partially
Jones L.	365	7'	Calif. Mariout	Drilled, alternate pairs of 'grae rows	3/25	partially
Jones L.	100	7½	Arivat Calif. Mariout	Drilled - 3 rows	5/6	too late
Mandeville	560	8'	Atlas - Oats	Drilled - rows	3/2-16 5/1-15	yes
McDonald	30	7'	barley	Drilled - 3 rows	4/27	no
Palm	60	7½'	Calif. Mariout barley & vetch	Drilled - 3 rows	2/13-14 5/1	no
Palm	10	8'	Calif. Mariout	Drilled - 3 rows	5/1	too late
Ringe	40	8'	barley	Drilled - 3 rows	ca. 5/17	too late
Terminous	456	8'	Calif. Mariout Arivat	Drilled - 2 rows	2/6-20 Mid-March	yes
Union	10	6'	barley	Drilled - 3 rows	ca. 4/15	no

	Acres	Cooperators
Successful	1,141	3
Partial success	465	1
Relatively unsuccessful	250	6

The following numbered paragraphs list the more pertinent facts and observations obtained from the 1957 inter-row planting program.

1) On McDonald Island, difficulty was experienced in re-ridging 7' interplanted asparagus although the barley was planted after conversion (ridging) to white. It was impossible to get as much dirt as desired for the ridge and some of the barley was taken out in the process. Some of the difficulty was caused by the rather crooked barley strips planted by the modified 3' grain drills. A reduction from three to one or two barley rows per strip planted more precisely down the center between the beds would help considerably on these narrow plantings.

2) Field tests on peat soil of the Agricultural Engineering Department's new set level mechanical asparagus harvester took place in 1957. It was deemed desirable to test the compatibility of inter-row planting with the machine. On April 23 California Mariout barley was planted 3 rows per strip, 6" spacing down centers between beds of machine adjusting rows. The inter-row barley was found to

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be not only compatible with the machine harvester, but to a large degree complementary to it. The nature of the machine is to cause a dry, dusty, weedless surface on the bed which was observed to be highly subject to wind erosion. The inter-row plantings acted to minimize this erosion and consequent dust.

3) A 10-acre inter-planting on Palm Tract was unsuccessful for about the same reason as a failure on McDonald Island during the 1956 season. The barley was shallow planted late in the season barely into borderline to only moderate moisture. As a result, only a 15%-25% stand was obtained and growth was less than half of normal. It would appear important in late season plantings to either furrow out down to moisture before planting, or to plant very deeply into moisture.

4) One cooperator on Palm Tract intended to leave his early planted inter-row (planted mid-February) through the ridging process and on into the white season. The beds were 7½' and flat at the time of interplanting. It was found impossible to convert to white asparagus without destroying the barley, much of which ended up buried in the ridged beds. As late as June 4 the workers complained about cutting difficulties due to this buried straw.

5) Four hundred fifty-six acres of particularly successful inter-row planting was put in on Terminous Tract from February 6 to mid-March. The 8' plantings were successfully ridged leaving the barley intact which had obtained a height of 14"-26" by the first of May. The barley strips consisted of two drilled rows at 6" spacing and were planted at a rate of 12½ lbs. per asparagus acre. (100 lbs. per barley acre). It was in these fields that wind profile measurements were taken (covered in another section of this report by H. B. Schultz) and observation of wind drift by smoke bombs were made. Observations on several occasions indicated the high degree of dust and erosion control provided by the interplantings. From observations of dust density during a dust storm, it was estimated that about 5 times as much dust was leaving the control (normal, unprotected) asparagus field as was leaving the adjacent inter-row planted field. By the end of the season, the control fields showed a considerable degree of erosion to the ridged beds, taking on a sharp peaked, triangular profile while the interplanted fields showed little or none of this damage.

6) As in 1956, an attempt was made to control the volunteer problem by chopping the immature heads from the barley. A stiff strip 6" wide and 9"-10" high resulted. The rows in all fields thus treated ran parallel to the generally prevailing late spring winds. Under these conditions, the chopped barley appeared to be only slightly effective. Very little stem and leaf regrowth appeared, but plants sent up new seed stalks, resulting in little, if any, volunteer control.

7) In the 1956 season, early planted inter-row barley on Terminous was left standing on a ridge of its own after the asparagus ridging process of converting to white. This caused considerable trouble to "jitneys" or asparagus sleds used to haul cut asparagus from the fields. During the 1957 season, the pairs of rows used by the sleds were not planted in order to avoid this problem. During the season, these pairs of bare rows were seen to be dust sources in interplanted fields, particularly in fields with rows running parallel to the wind. Interplanting these rows after conversion to white asparagus might solve this problem.

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8) Twice during 1957 observations were made bearing on the fire hazard late in the asparagus season of early planted barley. On June 13, a peat fire was discovered in Terminous asparagus interplanted in February. The peat fire had apparently been burning about two days and had grown to such a size as to encompass about 8' of barley interplanting. The barley was considered a fire hazard at that time by the grower and yet the barley did not catch fire from the burning peat even though the roots and bottom parts of the stems had been charred black.

On Mandeville Island, barley interplanted during the first two weeks of March was tested for inflammability the first week in July (the fern had been allowed to grow without destruction of the barley). The barley was dry and appeared to be a fire hazard. With a mild wind blowing more or less in the same direction as the rows, several attempts were made to ignite a row of barley. It was possible to set the barley on fire only after a considerable quantity had been pushed together to form a dense mass of material and even then, the fire carried down the row only a few feet and went out. It was not possible to start a self-sustaining barley fire. The narrow row with its inherent low density and the rapid dissipation of heat were probably the main factors.

Although these two observations alone do not prove that dry interplanted barley is not a fire hazard late in the asparagus season, it appears to be very strong evidence that the hazard is not so great as was believed.

9) The barley interplanting on Mandeville was done in two stages this year for the purpose of trying to solve both the volunteering problem and the fire hazard. Alternate rows were planted in early March while the remaining rows were planted the first two weeks in May after ridging for white asparagus. The thought behind this plan was that the early planted barley would be disked down after the later planted rows had attained sufficient height, thus minimizing or eliminating the volunteering and fire hazard associated with the early interplantings while still keeping some measure of dust and wind erosion control throughout the asparagus season. Actually, the early planted barley was never removed because much of the later interplantings were hardly high enough by the end of the short asparagus season to afford much protection at a spacing of every other asparagus row. In view of the experiences this year (paragraph 9 above and the variety-time of planting trials) it would appear that the volunteer and fire hazard problems might be better solved with cereal varieties better suited to inter-row planting.

10) It was observed that on June 10 barley interplanted early in February was completely brown and dry. Due to its sparseness caused by drying, it offered much less protection than it had earlier when it was green and leafy.

11) A highly successful set of barley inter-row plantings was planted on Bacon Island March 20-24. Three of the fields were interplanted into partially ridged green asparagus while the fourth field was flat at the time of interplanting. Row spacing was 8' and ridging for white done while leaving the barley intact. The grower found that the three fields which were partially ridged (a normal operation for this grower) prior to interplanting barley were much easier to ridge for white grass and to handle generally than the fourth field. He found it difficult to get enough dirt in the fourth field to build the white asparagus ridges without destroying some of the barley. As a consequence, a considerable amount of barley straw became incorporated in the beds. This difficulty could have been at least partially eliminated by planting narrower barley strips (1 or 2 rows instead of 3 rows) more accurately down the center between the asparagus beds. Certain modifications of the planters used could make this possible.

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These four fields are normally dustier and more subject to wind erosion than any of the fields on the ranch. This year, with interplanting, relatively little dust was seen to come from them and no noticeable erosion of the beds took place. By contrast, other fields, ordinarily less subject to erosion than the four, sustained a large amount of wind erosion and much drifted dirt and dust was found at the lee ends and in the ditches at the lee ends of these unprotected fields. Dust collectors on one occasion indicated about twice as much dust for a non-interplanted as an interplanted field. The interplanted field was, however, immediately to the lee of the non-interplanted field and some, if not most, of the dust collected in the interplanted field came from the upwind control field. These fields were all parallel to the general direction (west) of the strong winds.

12) The stand and growth of barley interplanted in a number of fields at various times throughout the season was disappointing because of lack of adequate seed bed. Hard, compact centers (the flat area between asparagus ridges) caused by tractor traffic were a poor growing medium for barley.

13) A small acreage trial on Union Island on 6' beds proved unsuccessful. The grower was unable to keep from damaging and destroying the barley even though the barley was interplanted after ridging for white asparagus.

14) All inter-row plantings put in after April 30 were ineffective due to their limited height by the end of the asparagus season (June 11). Some of these plantings would have had a beneficial effect the last two or three weeks of June had the asparagus season lasted that long.

15) Smoke bombs were set off in barley interplanted asparagus fields to investigate the mechanism by which the barley strips minimize erosion and dust. The wind was perpendicular to the rows. Observations at the time, and subsequent viewing of motion pictures taken at the same time, clearly indicated that rather than being a more or less impenetrable wall over which the wind blew, the strip of barley was a more or less porous wall through which the wind drifted at a considerably diminished velocity.

16) There was no indication of thrips being a problem at any time throughout the season.

17) Two cooperating growers successfully sprayed the barley strips with 2,4-D for weed control. They each used boom type sprayers with nozzles only over the barley strips. Other growers have not found weed control necessary in the barley strips.

18) All interplantings this year were drilled in with some type of grain drill. Most plantings were drilled with three rows per strip with 6" spacing. Nearly 500 acres of successful interplanting had two rows with 6" spacing. One and two drilled rows per barley strip appear to have particular merit where the grain is planted early into flat beds and maintained through the ridging for white asparagus and also in the case of 7' and 7½' beds where there is little room down the centers for the grain.

19) Rate of seeding varied with the grower and ranged from 12½ lbs. to 40 lbs. per asparagus acre. All appeared satisfactory although the 12½ lb. rate may have been a little on the light side.

20) The various experiences this year indicate that conversion to white asparagus in the presence of inter-row planting is likely to be successful only on 8' plantings of asparagus. Even with 8' plantings, conversion is more easily done when the green market asparagus has been partially ridged.

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21) Fall and winter volunteering was not a serious problem this year. Heavy fall rains started a majority of the grain. The rains were followed by a long dry spell and several frosts which essentially stopped growth. Most of the volunteered grain was killed by the normal process of disking the chopped fern.

From a study of the successes and failures of inter-row planting for dust control over the past three years, the following eight factors are listed as probably the most important involved in successful inter-row management.

1) The grower should have some fixed latest target date for planting and stick to it, just as he would any crop. Many of the failures have been due to late plantings occasioned by putting off the planting date until "everything is just right." Too little control is gained in planting after April 30 and every effort should be made to plant April 15 or earlier.

2) Planting the grain into an adequate seedbed is a must if the maximum growth rate and height is to be obtained from the interplantings.

3) Reasonably accurate planting is important. A straight strip down the exact center makes it far easier to cultivate the asparagus with a minimum interference from the grain strip and a minimum of damage to it.

4) Planting before conversion to white should, if necessary, be preceded by a furrowing out of the center or a partial ridging of the green market asparagus.

5) Experience has shown that a grower is more successful with inter-row each succeeding year he works with it.

6) Sufficient thought must go into pre-season planning - planters, any necessary disk modification, spray rigs if needed, seed barley, etc. Tractor drivers and foremen should be made to feel the importance of the interplanting rather than contempt for it.

7) A very important factor in successful inter-row planting has been the genuine desire on the part of the grower to stop wind erosion and its consequent damage on his ranch.

8) For inter-row planting to be successful, it must be considered an important, integral part of asparagus management and not just some luxury or sideline practice to be done at one's convenience.

Dust Control on Roads

No new experiments were tried in 1957 but it was the plan of the 1956 Orzan road treatment to follow it from one year to the next. Upon investigation in June, it was discovered that spoils from a drainage ditch had been dumped on the treated peat road and no sign of treatment could be found. The treated mineral soil road had not been defaced in any way but there was absolutely no treatment effect left.

Snow Fencing for Dust Control

The snow fencing used for dust control experimentation in 1956 was left up through the winter of 1956-1957 in order that wind profile experiments could be run on it in the spring. This necessitated hand removal of the dry asparagus fern in the winter time and hand weeding during the spring because of the impossibility of

using machine methods. These factors would make it impractical, if not impossible, to leave snow fencing up throughout the year if it ever were to be used. The wind profile experiments are covered in a separate section of this report by Dr. R. E. Schultz.

Bamboo Windbreak

By the middle of March the bamboo looked very poor, having been set back severely by frost the previous fall. A month later it looked no better and was suffering from drought although some of the plants were sending up new shoots. In early May, it began looking better although still poor and by the first week of June it was in fair condition and was growing although definitely suffering from lack of water. Water was supplied to the plants on June 18 at which time five of the smaller plants appeared to have succumbed to the heat and lack of water. Regular weekly watering from then on through the hot summer brought back all but one of the damaged plants. Apparently the larger plants had root systems deep enough to tap water table moisture. All plants responded to the extra water and care and by the middle of October were looking very healthy and most of them were putting on new growth.

In the fall, numerous rizomes about the diameter of a pencil or slightly larger were discovered which had been sent out by the larger plants to distances of two to five feet. Several of these were cut off in October at various distances from the parent plant to determine if they can sustain themselves and send up a shoot the following spring. The purpose was to find out if bamboo windbreaks can be controlled by cutting off in the fall all rizomes encroaching on crop land.

Sharp frosts on four nights in early November and on two nights in late November caused practically no damage to the bamboo at all. Most of the young, still expanding, shoots were even untouched by the freezing temperatures. It is not understood why the bamboo was so damaged by frost in 1956.

New Crop Possibilities

As was mentioned in the 1956 report, these are joint projects with the Agricultural Extension Service (and in the case of blueberries, also with the Pomology Department) with the local Farm Advisor's Office taking the main responsibility for the field work.

Christmas tree variety trial. The attempt at stump culture on the Monterey Pine cut for a Christmas tree in December 1956 was not successful, the stump dying by December 1957.

By December 1957, four species were tall enough to be considered for cutting as Christmas trees. These were Allepo pine, Monterey pine, Arizona cypress, and Sequoia gigantia. Upon close examination, it was found that 80% of the Allepo pines were culls due to double trunks, crookedness, one sidedness, or poor shape. The remaining 20% could not be classed as better than #2's. The Arizona cypress were all too tall and slender to be considered as Christmas trees

and a large majority of them showed sings of sickness. Several fairly healthy specimens grew to a height of 11 feet and will continue to be observed as possible windbreak material. Of the 1955 planted redwoods, 35% were found to be dying while 20% of those planted in 1956 were dying and the balance were not healthy. None of the redwoods made satisfactory Christmas trees. The Monterey pines showed definite signs of sickness in 7 out of 29 trees, apparently due to root rot. Several others had an unthrifty look with browning of interior needles. Eleven Monterey pines were cut as Christmas trees with three going into private homes for observation and seven going to a cooperating Christmas tree lot for sale on the retail market. The trees were judged to be mostly #2's. The seven were put on the market late in the season (last weekend before Christmas) when competition was becoming keen and tree prices were being dropped. Five of the seven were sold at prices comparable with fir trees, $2.50 to $4.00 for 4' to 6' trees. Two were not sold. The observed trees in private homes were liked very much and stood up well with little or no needle fall. On the basis of the poor yield and quality, it was felt that the above species would not be suitable for Christmas tree plantation stock in the organic soils of the Delta.

The remaining species were all too small for cutting as Christmas trees. Of these, the Scotts pine were all sickly or dying and the firs looked ragged and not normal. The condition of the firs might have been due to the serious competition of tall weeds throughout most of the year.

Blueberries. Since the blueberry variety trials are fully reported under Experiment Station Project No. 1386 (Pomology Department, Davis), only the highlights will be reported here. In March more plants were set out to fill in the spaces where losses occurred during the previous year. New varieties were introduced bringing the total to eighteen. Many of the plants were set back moderately to severely due to a heavy set of blossoms and fruit which was allowed to remain on the plants. No apparent damage was done to the plants by March frosts although some plants were blossoming and leafing out at the time. In May, on the Mandeville plot, 35% of the plants were found to be in very poor condition (heavy set of fruit but with only a few, wilted leaves). The plants were stripped of fruit, pruned, and watered. Soil analysis showed a pH of about 5 throughout the profile but high salt (7.5 milli mols for saturation extract) in the top 4". An immediate change in irrigation practice was recommended. When this change was finally accomplished (flooding down the berry rows rather than furrow irrigating, drainage ditches between the rows to carry away the leachings, larger and more frequent application of water) the plants recovered and by mid-summer no further losses had occurred and the surviving plants showed no signs of salt burn. Losses on the Palm Tract plot occurred from scalding when a portion of the plot was inadvertently flooded to a depth of several inches for two to three weeks during the summer. Only those plants which were in the deepest water for the longest period succumbed. Losses occurred on the Rindge Tract plot because of the dry nature of the soil, infrequent irrigations and weed growth. It was concluded that the berries stood up remarkably well and were well adapted to Delta climate and soils, despite the moderately heavy losses, in view of the very unfavorable conditions under which most of them were being grown.

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Irrigated pasture. Cattle continued to do well as long as they were furnished 1 to 2 grams of $CuSO_4$ $5H_2O$ per head per day in their drinking water whenever they were not being given supplementary dry feed. If the copper were withheld for a week or two, the cattle would become loose and scour.

Monthly sampling of forage in the various fields for analysis of Cu, Mo, and SO_4-S was continued. The analyses being done by Dr. C. M. Johnson and Tom Arkley of the Department of Soils and Plant Nutrition, Berkeley, are not yet completed.

Although the relatively high copper content in the forage (9-14 p.p.m.) suggested little hope for positive results, it was decided to try copper fertilization of the soil as a means of raising the copper content of the forage. The aim was to attain a forage sufficiently high in copper to eliminate molybdenum toxicity in cattle. A 99' x 66' fenced exclosure was built in a uniform spot in the peat pasture. This was subdivided into three 1/20 acre treatment plots. Treatments broadcast on February 12 were control, 5 lbs. $CuSO_4$ $5H_2O$ per acre, and 50 lbs. $CuSO_4$ $5H_2O$ per acre. The first samples for analysis were taken after a rain and regrowth from a close clipping minimized leaf contamination from the broadcast treatments. Analyses, performed by Dr. C. M. Johnson and Tom Arkley, are as follows:

Copper in clover, p.p.m.

	Control	5# Blue-stone/acre	50# Blue-stone/acre
February 27	6.2	10.0	48.6
March 18	10.1	10.1	14.3
April 24	9.5	10.1	10.1

Analyses also show that the Mo uptake was unaffected by the copper fertilization. The above data indicate the impracticability of increasing forage copper by fertilization.

In conjunction with the pasture studies, a small 15' x 15' observation plot of Coastal bermudagrass was established in the fall. It will be watched for its reaction to added nitrogen fertilizer, its ability to control weeds, and its ability to form a good sod.

Subsidence on Rindge

In cooperation with Clyde Houston, Extension Irrigation Specialist, Davis, a traverse was laid out on Rindge Tract and the first of a proposed series of elevation measurements taken. This study differs from the traverse on Lower Jones, Mildred, and Bacon Islands begun by Walter Weir in 1922 in that it will not attempt to measure the average subsidence of the island as a whole. Rather, the subsidence of individual crops or cropping systems will be followed. This year the traverse covered irrigated pasture, barley, corn, and potatoes. The barley land will become asparagus land in 1958 and the pasture will become asparagus in 1959 or 1960.

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Leaching by Flooding

Evaluation of a more or less new method for leaching peat soils was done in 1956 cooperatively by the San Joaquin County Farm Advisor's Office and the Department of Irrigation, Davis. The method consisted essentially of ponding water in small basins surrounded by temporary drainage ditches. It proved highly successful in leaching salts from the soil profile.

Little is known, however, of the effectiveness of a more common method of leaching - whole field flooding - except that crops following the flooding usually do better. To learn more about salt movement in whole field flooded peat soils, six locations were chosen in two fields which were to be flooded in the fall. Samples from two profiles to 4' at each location were taken before and after the flooding. The samples have been dried and partially prepared but not analyzed. It is anticipated that electrical conductivity of the saturation extract will be run on the samples and perhaps other salt measurements as well.

Rolled vs. Unrolled Peat Soil

It has been suggested from time to time that the use of a roller on peat soil to compact and smooth the surface might aid in dust control. For a number of reasons the suggestion was believed to be without sufficient merit to warrant experimental time and effort. Observation of a bare field one day substantiated this belief. The field was bare and dry and had previously been harrowed in a diagonal direction. It was potentially dusty. On the day of observation, it was being rolled with large rollers about 3' or 4' in diameter. There was a moderately strong wind blowing and, although there was no dust at all coming from the unrolled portion, a large amount of dust was seen blowing from the rolled portion. The effect of the rollers was to pulverize the surface soil causing it to be highly subject to wind erosion.

Soil Temperature Measurements

It is generally believed among asparagus farmers that flooding of the fields for one to three weeks in the winter will cause green market asparagus to come on in volume earlier in the year than if the fields were not flooded. This widely held belief appears to be not without foundation. One of the theories advanced to explain this observation is that after flooding, the soils warm up faster than soils with no flooding. A joint experiment with Jack Underhill, Farm Adviser, San Joaquin County, was conducted to test this hypothesis. Two Auto-Lite recording thermographs with 5' leads, previously calibrated against one another, were set out in a pair of asparagus fields late in December, 1956. The bulbs were buried in the asparagus ridges at 12" depth, just at the asparagus crown level. One of the fields was flooded for a period of about three weeks during January then drained. While the one was flooded, the relative temperature of the two varied with the weather but, in general,

they were about the same. After draining, the temperatures in the two fields remained the same at 50° to 52° F. at 12" depth. On February 27, prior to the first asparagus cutting, a count of spears on flooded and non-flooded fields showed more than five times as many spears per hundred feet of row on the winter flooded field as on the non-flooded field. This, despite the fact that the non-flooded field was considered the "earlier" field when neither were flooded. This experiment would indicate that the earlier production on flooded fields is caused by some factor other than temperature difference.

Subsidence on Terminous Tract

One of the unknowns about subsidence of organic soils in the Delta is how much of the total loss is accounted for by dust. One indirect way of estimating this loss is to measure the relative subsidence of two adjacent sites, one of which has been protected from loss by dust. Such a situation presented itself in 1957. About 20 years ago the Western Pacific Railroad built a spur on Terminous Tract which jutted out into cropland. The small triangular enclosure has not been cropped since that time and has sustained a weed cover. Presumably no dust has been lost from the area. The peat soil within the spur now stands at a noticeably higher elevation than the surrounding crop land. Assuming that the subsidence due to oxidation is the same inside and outside the spur, the difference in elevation would represent dust lost from cropped fields. The measured difference in elevation was 17". This is about 0.85 inch per year or 25% of the total subsidence (based on the rate of subsidence of Lower Jones, Mildred and Jones Tracts - 3½" per year). This 0.85 inch per year must include all wind erosion and whatever increased oxidation might be caused as a result of working the ground for crop production.

San Joaquin County Peat Soil Statistics

In order to gain a better understanding of the peat soil problem, the following statistics for San Joaquin County were gathered. They are based on 1956 data.

Gross peat soil acreage - - - - 94,000 acres

Acreage by crop - -

Asparagus	32,000
Barley	25,000
Corn, grain	22,000
Potatoes	7,000
Sugar beets	2,000
Wheat	2,000
Sunflowers	1,000
Celery	800
Carrots	400
Onions	400
Spinach	400
Total	93,000 acres

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Broken down roughly this table condenses to:

	Acres			Of Total
Asparagus	32,000		Asparagus	1/3
Winter grain	27,000		Winter grain	1/4
Corn, grain	22,000	or	Corn	1/4
Potatoes	7,000		Misc.	1/6
Misc. field crops	3,000			
Truck crops	2,000			