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Dust Storms

Observations of peat dust storms were made throughout the calendar year 1958. The first recorded storm occurred May 9, 1958 and was more than five weeks later than the first storm in 1957, while the last storm occurred on November 10, 1958. As in the past, they varied from mild and localized to severe and more or less general. Twenty-four storms were recorded altogether, two of which were caused by northerly winds and which by-passed Stockton and Lodi. No storms were caused by southerly or southeasterly winds in 1958.

As during the past two years, 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 fewer westerly dust storms hitting Stockton and/or Lodi were recorded in 1958 than in any of the previous three years, slightly more June storms were recorded in 1958 than in the other years. It was generally conceded locally that 1958 was less dusty than the three previous seasons. It should be noted that no very severe storms occurred in 1958 and those recorded as severe were on the mild or light side and would probably have been recorded as moderate storms in more dusty years such as 1955 and perhaps 1956. It is felt, as noted in previous reports, however, that the judgment of storm severity was sufficiently uniform throughout the season to get valuable and reasonably accurate information as to dust storm frequency-severity distribution throughout the year. The following tabulations fall under the same headings used in the 1957 report which should be consulted for comparison between 1958 data and that for the three previous years.

Westerly dust storms hitting Stockton and/or Lodi:

Number of storms by month

	1958
January	0
February	0
March	0
April	0
May	6
June	12
July	3
August	1
September	0
October	0
November	0
December	0
Total	22

Number of storms by half-months for May and June

		1958
May	1-15	1
May	16-31	5
June	1-15	1
June	16-30	11

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Valley of storms by severity:

	Number of storms by severity 1958
Very severe	0
Severe	3
Moderate	4
Mild	8
Very mild	7

Severity by months, 1958:

	Number of storms							
	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Very severe								
Severe				2	1			
Moderate				4				
Mild			4	2	1	1		
Very mild			2	4	1			

Northerly dust storms generally by-passing Stockton and Lodi:

There were 2 storms in this category for 1958.

Dates:

Storm category	1958
Mild	11/15
Very mild	11/16

In last year's report the 1955, 1956, and 1957 statistics for westerly storms were reduced to percentages and the distribution of storms within the years compared. Despite the fact that the total dustiness of the years varied greatly, the distribution of storms within the years was remarkably similar. Because of this similarity and because there were no large abnormalities in the weather patterns of those years, the data for the three years was averaged together to give a picture of what might be considered a normal distribution of dust storms throughout the year.

An abnormality occurred in the weather pattern in 1958 which had a direct bearing on dust storm magnitude and distribution. Unseasonably heavy rains in March and April accompanied by floods on many delta islands and above average rain in May created wet and cloddy soil con-

planted April 14 was 17"-21" tall while Atlas planted at the same time was 29"-32" and Rojo was 30"-33". The California Mariout in 1958 was considerably shorter for any given planting date than the same variety in 1957. This appeared to be rather generally true of barley plantings throughout the area and probably reflected the cool wet spring. None of the barleys were dry enough by the end of June to constitute a fire hazard but all but two of the poorest varieties planted May 12 were completely dry by July 14.

It would appear from the work in 1957 and 1958 that Hero and Atlas barleys have nothing to recommend them for further consideration but that California Mariout, Arivat, and Rojo, while being far from ideal, should be considered for further testing.

The oats. Bannock and Sweedish oats from Idaho were used. Since Sweedish was replacing Bannock in Idaho agriculture and Bannock seed would be difficult to obtain in the future, Sweedish was compared to Bannock to determine its suitability for inter-row planting. There appeared to be little or no difference between the two oats in height, stiffness, leafiness, age to maturity, rate of growth, or resistance to yellow dwarf and rust. They both appeared to be equal or superior to the barleys in leafiness and stiffness, and have a longer growing season resulting in far less viable seed by the end of June as well as staying green at least two weeks longer. Neither variety was hit by yellow dwarf to nearly the extent that the barleys were. Some rust occurred on the oats but it did not appear to seriously hamper the growth. By mid-May, April 14 planted Sweedish oats were 7"-10" tall, averaging 1"-3" shorter than the barleys planted at the same time. April 21 planted Sweedish at 7"-9" also averaged 1"-3" shorter. A week later, May 21, when Sweedish oats were 7"-12" high, this discrepancy in height was more pronounced, the barleys averaging 4" taller. By the end of May the oats were up high enough to offer a considerable degree of protection (11"-14") although they were still shorter than the barleys by 4"-8". The oats, however, were far more leafy and dense than any of the barleys except California Mariout. On June 11 the oats had all but caught up with the barleys for all planting dates and were superior as windbreaks because of their stiffness and leafiness. It is interesting to note that the stature of Bannock oats at any given time in 1958 and for a similar planting date was almost identical to that recorded for Bannock oats in 1957. The one exception was the end of March planting where the flooding and excessive wetness obviously hampered the growth in 1958. Although Bannock and Sweedish oats appear to be inferior to the better barleys during May, they appear to be superior to the barleys during June, even when planted as late as the end of April. By the end of June the oats planted from April 14 to April 27 had reached average heights of 29"-42".

The wheats. The durums Sentry and Nugget did not do well in 1958 compared to 1957. The stands were only fair to poor and the plants seemed not to be vigorous, perhaps due to the weather. Of the two, Sentry was the most satisfactory in every respect but reached only about

2/3 the stature it attained in 1957. It is felt that this variety should be tried again in another, more normal, year. By mid-June, Onas 53 wheat appeared to be superior to any of the barleys as an inter-row plant. It had adequate stature, stiffness, and leafiness and was late in maturing. Its drawback as compared with the barleys, like the oats, was its relatively slow early growth rate. It remained slightly behind Bannock and Sweedish oats for the first 5 or 6 weeks and had rather weak, thin leaves when young. All of the wheats, however, were but only very slightly affected by yellow dwarf and they remained green or partially green beyond the middle of July.

Ryer 15. This sorghum was found to be very stiff and upright, although only moderately leafy. Its stiffness, leafiness, height (maximum height 40"-48"), and growth rate make it a distinct possibility for normal inter-row planting. One drawback is its stiff stalkiness which may make it too brittle to withstand the trampling of asparagus harvest. Ryer 15 is superior to the oats and wheats tested in early growth rate and only slightly inferior to the barleys in this respect. It remained green well into the summer.

Sudangrass. Sudangrass was known to grow adequately tall in the organic soils of the delta and to cause little or no volunteer problem because of the nature of its seed. Sudan 23 was grown in the variety trials to test how early it could be successfully planted and whether its early growth rate would be adequate to make it a satisfactory inter-row plant. All plantings did well with early growth rates approximating the barleys. By June 19 it was judged to be the best looking and most promising of all the tested varieties for inter-row planting. At this time it had a height of 4'-5' in all plantings made April 27 and earlier. This height and density, however, would prevent a harvester from "working" two beds at a time, a very common procedure. At this stage it appeared the workers would have to cut only one bed at a time or the sudangrass would have to be planted in alternate rows. The grass was not too high at this point to prevent a worker from crossing the strip periodically for the purpose of "handing over" asparagus to the next row. The sudangrass continued to grow, however, and by the end of June the first two plantings (March 31 and April 14) had reached heights of 6' and 6½'. This height would probably seriously interfere with the normal work and movement of workers in a field, even if spaced every other row. In addition, the great bulk of plant would be somewhat difficult to handle and work down at the end of the season. It appears that what is needed is a variety of sudangrass with growth characteristics similar to Sudan 23 except with a terminal height of 4 to 5 feet under delta peat conditions. The Sudan 23 in this trial reached 7½'-8' by mid-July.

Forage sorghums and millets. These plants were tried for the purpose of finding a fast tall growing plant that could be spaced at intervals of 10 to 12 rows in asparagus fields. They should be capable of reaching to heights of at least 6' shortly after mid-May and certainly by the first of June. DeKalb forage, Waxy Atlas, Hegari, Cattail millet, and Starr millet were the varieties tried. The early growth rate of all these summer forage grains was far too slow to warrant further consideration as wide

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spaced windbreaks in asparagus. By June 11 they were only 2'-3' tall and not particularly stiff or stalky at this stage. A maximum of slightly less than 6' was reached by Cattail millet by the end of June, at which time the other varieties had reached maxima of only 3'-4'. The slow early growth rate coupled with the generally "spready" growth habit in early stages also rule these out as suitable plants for normal inter-row planting.

Sunflowers. Grey Stripe and Black Manchurian sunflowers were tried for the same purpose as the forage sorghums and millets. Sunflowers, while falling short of the 6' goal by June 1 for wide spaced windbreaks were far superior to the forage grains and show considerable promise as annual windbreaks, particularly in such specialized applications where protection against wind erosion is particularly needed after the first week in June. By May 28 Grey Stripe sunflower (the faster growing of the two varieties) ranged from 17"-23" for the April 27 planting to 32"-50" for the March 31 planting and was by far the tallest and fastest growing plant in the entire variety trial. On June 18, Grey Stripe was 4 3/4'-5 3/4' for the April 27 planting and 5½'-7' for the March 31 planting. The heights had increased to 6'-7' and 6 3/4'-8' by the end of June. The density of foliage of a single row of sunflowers was far from ideal but even so, there appeared to be sufficient density to have a very significant moderating effect on the wind. Experience in these plots indicates sunflowers should have a stand density of 20 to 30 plants per 10' of row for windbreak purposes. Two factors would seem to rule out sunflowers as a normal inter-row (every row or every other row) plant. When small (up to 3') they would be easily trampled and not recover. When over 3' in height they would seriously impede harvest (difficult to walk through). Sunflowers remained green throughout the asparagus season and did not set viable seeds.

Corn. King Phillip corn grew more rapidly from early plantings than was anticipated and proved to be intermediate between forage grains and sunflowers in this respect. Sunflowers were slightly superior to corn in windbreak density but corn would have the advantage of allowing 2,4-D spraying if broadleaf weeds were a problem. Heights of March 31 planted corn were: May 28, 20"-30"; June 11, 42"-64"; June 26, 6½'-7½'.

Castor beans. Four varieties were tried and all were found unsuitable for any form of inter-row planting or annual windbreak. They were slower growing than most of the other varieties tested and when of sufficient height for use as inter-row plantings, they had taken on too much of a spreading habit (as wide as they were tall) and were tender stalked.

Fava beans. Fava minor proved to be adequately stiffly erect and leafy but was a slow grower. It was very tender and probably would not stand much trampling. Since it is normally a winter grower, it should be tried as early season inter-row for green market asparagus.

Of the 25 varieties discussed above, 11 are considered worthy of further testing and should be compared in another season in a variety-time of planting trial. These varieties are: California Mariout, Arivat, and Rojo barley; Sweedish oats; Onas 53 and Sentry wheat; Grey Stripe sunflower; King Phillip corn; Ryer 15 milo; Sudan 23; and fava beans (early plantings). In addition, any short stature sudangrass that can be found should be tried.

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Field Scale Inter-row Planting

Unlike previous years, the 1958 inter-row planting program was affected far more by the unusual weather conditions than by any vagaries of the asparagus market. Not only did conversion to white asparagus take place later than usual (conversion was only well under way by the end of April) but the high degree of weediness occasioned by excessive soil moisture postponed the time when asparagus fields could be made ready for inter-row planting. As a consequence of these conditions, only two co-operators were able to do any inter-row planting. One was able to get 347 acres interplanted to barley in February and early March, leaving 35 acres unplanted as control. Excessive weed growth and wet soils necessitated the removal of all but 34 acres prior to conversion to white asparagus. The inter-row planting during the green market season proved to be of no value since the weediness and wetness of the soil effectively prevented wind erosion and resulting asparagus damage during the early spring months.

The fields with removed inter-row were replanted with Bannock and red oats on May 5-13 after conversion to white asparagus. By the end of the cutting season for this grower, May 20-24, only the Bannock variety had attained a stature sufficient for any measure of wind erosion control. The 34 acres of early interplanted barley reached a height of 28"-30" by mid-May, a desirable height for this time of year - the beginning of worst part of the dust season, but was drying rapidly as early as June 2 and was capable of burning June 25 or before. No winter volunteer occurred in 1958 from this barley because of the dry early winter.

The other cooperator also interplanted a large field for wind erosion control in green market asparagus but wet ground and flooding of the field due to heavy rains killed some of the grain and hampered the growth of much of what was left. This planting was destroyed in the process of conversion to white asparagus. Barley and Bannock oats were again interplanted in other fields on May 7 after conversion to white and remained until after the asparagus season. Because of the late planting date, none of the inter-row was up high enough to be very effective until after the first week in June.

Plantings by both cooperators were more or less parallel to the prevailing late spring winds although one observation occurred during a freak windstorm which preceded a heavy thunderstorm when the wind was more nearly at right angles to the rows.

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Table of plantings:

Island	Acres	Row Spacing	Grain	How Planted	Date Planted	Effective
Terminous	347	8'	barley) red oats)	Drilled-2 rows 12" spacing	2/14-3/10	Only 34 acres
Terminous	160	8'	red oats	Drilled-2 rows	5/5	No
Terminous	24	8'	Bannock oats	12" spacing	5/7-13	Yes
Rindge	40	8'	barley) Bannock oats)	Drilled-1 row	3/19	No
Rindge	70	8'	barley) Bannock oats)	Drilled-1 row	5/7	Yes

The following numbered paragraphs list the more pertinent management facts and observations obtained from the 1958 inter-row planting program.

1) Too late to be included in the 1957 report was information obtained relative to the summer mulch formed by inter-row barley straw in four fields on Bacon Island in 1957. This straw was exceptionally dense and created serious problems in weed control during the summer months. The large volume of straw prevented the disks from operating in a normal manner which made several extra diskings for weed control necessary and made the diskings slower and more laborious. The result of the extra diskings (beside the extra cost) was that these fields were dustier during the summer than fields which had not been inter-rowed. An investigation showed that the inter-row barley had been planted at the excessively high rate of 55 to 60 pounds of barley to the asparagus acre. Experience indicates that 15 to 20 pounds is ample. This was the only instance in three years of experience with inter-row planting where barley straw gave any trouble during the summer months.

2) The fields discussed in paragraph 1) above also gave rise in the winter of 1957-58 to the most serious instance of winter volunteer problem in three years. Late in January, 1958 the volunteering barley was of a "clumpy" nature and was 4"-8" tall. By the end of January it covered variously from 10% to 100% of the ground and was 5"-12" tall. Two extra diskings had already been used in an attempt to control the growth. The cool, damp weather, coupled with the clumpy nature caused by entire barley heads germinating as a unit, prevented the soil mass around the roots from drying out, even though uprooted. By April 4 a considerable amount of the barley had reached a height of 20"-30" and was seriously interfering with the asparagus harvest. The barley was finally controlled at the time of conversion to white asparagus. The two main factors undoubtedly contributing to the seriousness of the problem

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were the excessively high seeding rate (mentioned in paragraph 1) and insufficient effort at control during the early, drier part of the winter.

3) Comparisons of very late (end of first week of May) field plantings of barley, Bannock oats, and red oats as inter-row grains indicate the distinct superiority of barley under such conditions, the oats being too slow in their early growth rate. In addition, the red oat was an unsatisfactory plant because it was far too sparse and spindly, most of the leafiness being at the lower 1/3 of the plant with only a thin, nearly leafless stalk sticking into the air.

4) On June 25 tests were conducted to determine the inflammability and fire hazard of dry barley interplanted in asparagus rows. Inter-row barley planted February 15 on Terminous Tract was used. The wind was mild to moderate and somewhat gusty, being estimated at 6-10 mph and had a direction of 45° to the barley rows. Four fires were successfully started in the barley but only two of these continued to burn to the end of the row, distances of 24 feet and 57 feet. The other two fires traveled distances of only 18 feet in one case and 6 feet in the other before going out of their own accord. In none of the cases did there seem to be any danger whatsoever of the fire jumping to an adjacent row, a break of only a few inches in the fired row being an almost insurmountable barrier to the fire. The barley was difficult to light and firing was only successful when tried near the base of the plants where there was either a dense accumulation of trash or barley was purposely bent down to form a dense mass. It was necessary to shield the matches and barley from the wind in order to start a fire. In two locations, fires were attempted (several trials at each location) in the tops of the barley but no self-sustaining fire could be started. The reason appeared to be a matter of insufficient density of inflammable material. For the whole experiment, a total of 19 matches were used from which only 4 fires resulted and two of these went out after burning only a few feet. In view of the above, as well as the 1957 experience with peat and inter-row fires, (p. 72 of the 1957 report) an accidentally caused fire in dry inter-row barley would seem only a remote possibility and the seriousness of such a fire would not likely be great providing the slow burning peat fire resulting from the burning barley trash were put out.

5) In 1958, as in 1957, late plantings, particularly plantings after the first of May, resulted in inter-row which was not tall enough to be effective until the latter part of the critical dust period of mid-May to the end of June. This was due in large part in the case of one cooperator to the need for a tool bar tractor to pull the special inter-row grain ~~grain~~ planters at a time when all available tool bar tractors were busy for an extended period during the conversion process of green to white asparagus. This factor prevented one cooperator from planting any inter-row protection although he had planned to put in at least 90 acres. He did not have any tool bar tractor available for planting until the middle of May even though the fields he had wanted to protect were ready for interplanting by May 1.

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6) As has been observed in previous years, barley that is inter-planted in February and is kept through the conversion process is brown and dry by mid-June. In this state it is far more sparse than when greener and offers less protection. It was noticed, however, that this sparse barley, being 22"-26" tall gave superior protection to asparagus beds than May 5 planted Hannock oats which were 9"-15" tall, very leafy but not yet very stiff and upright.

7) The 1958 plantings again brought out the need for reasonably accurate planting down the center of the row. Crooked or non-centered grain strips frequently gave rise to some loss of inter-row planting when re-ridging of the asparagus beds was necessary, the ridging disks cutting out that barley which was too close to the asparagus ridges. In addition to loss of inter-row planting, cut out straw was frequently incorporated in or thrown onto the asparagus bed, making harvest more difficult.

8) Even though inter-row planting in the Ridge Tract fields was done after the initial white ridge building at conversion, subsequent re-ridgings to build the ridge higher left the inter-row grain strips on small, steep sided ridges in between the asparagus beds. This also occurred in the early Terminous plantings of barley which were maintained throughout the season. These small ridges, generally 4"-6" high and 8"-20" wide, are a disadvantage to the workers in the fields since walking along their edge and back and forth across them is difficult. Although there may be no solution to this problem with inter-row that is planted early and maintained throughout the season, it should be possible to minimize the problem with inter-row planted after the first ridging for white asparagus. If the centers (flat space between the asparagus beds) were furrowed or hollowed out prior to planting so that excess soil needed for subsequent re-ridging would be on the shoulders of the bed, or at least along the edges of the centers, then little in the way of a center ridge would result when re-ridging takes place. This furrowing out could take place simultaneously with planting, thereby eliminating the necessity for an extra operation.

9) A form of inter-row planting was tried in spinach by one cooperator for the purpose of preventing wind erosion damage to tender young spinach plants during January and February. Very strong dry north winds occasionally blow this time of year and can cause considerable damage. Barley strips of 4 drilled rows with 12" spacing were spaced every 28 yards apart with 60 spinach rows between. The barley was planted before the spinach and by the end of January was up 3"-7" when the spinach was up just 1". Although no strong wind occurred to test its effectiveness, it is doubtful that the barley at such wide spacing would have been very effective. Single rows of barley at intervals of 12 to 15 spinach rows would probably have been better.

10) At the end of the season in 1957, 280 acres of inter-row barley on Terminous Tract were disked down in such a way as to confine the straw as much as possible in the centers between the asparagus rows. Then this barley volunteered in the winter of 1957-58, 90-95% of the barley growth was within a 3'-3½' strip down the centers. Normal cultivation for

weeds largely, but not completely, destroyed the barley. That which was left was not a serious problem since little of it was on the asparagus beds where it would interfere with harvesting. It was further noted that where fields received rather complete and even flooding, (a common winter practice in asparagus) no volunteer barley survived.

11) White asparagus fields are subject to serious wind erosion for two or three weeks after the end of the harvest season and the knocking down of beds, by which time the fern has grown enough to offer some cover and protection. Inter-row planting left intact during this period can act as a protective device until the fern has grown sufficiently. One co-operator was able to successfully split his beds open by means of a pole drag followed by a disk while the inter-row grain was left more or less intact. Later the grain was taken out by standard "V" weeding knives. The intact grain, although somewhat knocked down in the bed splitting process, provided considerable protection to the field from wind erosion while the fern was growing.

Wind erosion evaluation. Several methods of evaluating inter-row planting in terms of erosion control were planned for the 1958 season but the peculiarity of the season and the generally late and poor quality of inter-row plantings available for study made possible the use of only two of the methods. The most useful was the observation method whereby relative dustiness of various fields was judged under various conditions of wind. The other method used the principle of collecting saltation grains and coarse dust in simple impinger type collectors. This method has the disadvantage of having to anticipate where and when a dust storm is going to take place in order to have the collectors out in the field. Experience has indicated that one cannot safely leave the collectors unattended out in the field for extended periods of time (several days) without running the risk of sample contamination by curious farm workers or unannounced tractor work. The impinger collectors used were the tall, spiral baffle type described in other reports.

On June 12 impinger samplers were set out at Terminous to test the relative effectiveness of tall, though drying, early planted barley and the late planted, rather poor red oats. A heavy thunder shower lasting about 3/4 hour was preceded by an intense local dust storm which lasted about 5 minutes. The wind was from the northwest and blew at an angle of 45° to the rows. The 1/2" of water in the bottom of the cans and some mud spattering made exact evaluation of the collected dust impossible. However, the two cans set out in the barley inter-rowed field contained very little dust while the can evaluating the short and poor red oat inter-rowed field contained an estimated 10 times as much dust. This difference in dustiness was confirmed by visual observation, the unprotected fields or those only poorly protected by short red oats were blowing heavily while only a slight amount of dust could be seen coming off the fields protected by the early planted barley inter-row. Late planted Bannock oats which were 9"-15" tall by this time were somewhat inferior to the barley but highly superior to the red oats.

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Dust collections and observations of the Ridge Tract plantings were confusing. Numerous observations and dust collections indicated nearly equal, but not large, amounts of dust coming from inter-row and adjacent control fields. It was felt on the basis of previous experience that much more dust should have been coming off the control than off the interplanted field, perhaps 4 to 6 times as much. Close examination showed the inter-rowed fields to have a somewhat smoother, less cloddy and aggregated surface and they seemed to contain more sand particles. They appeared to be more inherently subject to erosion. Discussion with the cooperating grower confirmed this. It had been his observation in the past that the two treated (inter-rowed) fields were far more subject to erosion and consequent dust than any nearby fields. Fields about 1/4 mile to the northeast, but in the same camp, were believed by the cooperator normally to be nearly as subject to erosion (dusty) as the inter-rowed fields. Using these fields as control, observation pointed to a high degree of erosion and dust control by the inter-row plantings. During a windstorm, very little dust could be seen coming from the inter-rowed fields whereas large rolling sheets of dust were observed blowing from the controls 1/4 mile to the NE. One set of dust collections became possible before the end of the asparagus season using these fields as controls. The collections were made during a mild dust storm on the afternoon of July 1. Wind was at an angle of approximately 20° to the rows. Collector height in the following table refers to the height of the base of the collectors above the tops of the asparagus beds where they were stationed.

Collector Number	Collector Height	Treatment	Grams Collected
7	0"	Control	2.25
8	0"	Inter-row	0.24
9	0"	Inter-row	0.56
10	0"	Inter-row	0.86
11	30"	Control	1.04
12	30"	Inter-row	0.21

These data would indicate that the inter-row planting had been effective in reducing the dust by a factor of 3 to 8 times. Actually, the inter-rowed fields were at a disadvantage in this comparison since previous heavy winds had blown most of the fines from the control field and had left a less erosive, coarse surface. The high variability in the amount of dust collected from the inter-rowed field reflected the considerable variability in height and stand of the inter-row grains at that date. Low placed collectors particularly tend to reflect their immediate surrounding conditions. Another observation on these fields indicated the effectiveness of inter-row planting in minimizing wind erosion. By the end of June, the asparagus beds in the field used as control in the above table (and some adjacent fields) had been eroded to the point where their cross section

would resemble that of a volcano - flat, straight sides, and sharp peaks. The inter-rowed fields, on the other hand, still maintained the high, steep-sided bed shape with more or less wide, rounded top. This, despite the contention of the cooperator that the inter-rowed fields had always been more subject to wind erosion in the past than the control to which they were compared. The cooperator's feeling was that the inter-row planting had done a lot of good in cutting down the dust and minimizing erosion of the asparagus beds.

Several medium sized "dust devils" were seen to traverse the Rindge plots. In every case either a considerable diminution (estimated at 2-4 fold) in intensity was noticed as it moved from ridged white asparagus or other bare ground into the interplanted fields, or a considerable increase in intensity of the "devil" as it moved out of the interplantings into normal ridged fields. These observations are in line with similar observations in previous years and indicate that inter-row planting will have a considerable moderating effect on the dust picked up and carried by the dust devils which are so numerous during the spring months in the delta.

Planter redesign. One of the frequent difficulties with inter-row planting has been the problem of accurately planting the barley strips down the centers between the asparagus ridges. This was particularly true in 1957 with the University's specially modified Van Brunt tricycle type 5-opener planters. The planters were connected to the tractor tool bar by a 6" length of chain to allow sufficient vertical movement of the tractor without disturbing the loading of the planter front drive wheel. The chain also acted as a pivot to allow tracking of the planters when turning corners. Unfortunately, the flexibility of the chain also allowed a yawing motion of the planters with their front ends swinging from side to side. This led to crooked drilled rows and a serious instability to the somewhat top-heavy planters. To obviate these problems, a hitch to replace the chain linkage was designed and built. It was flexible in a vertical plane but allowed no yawing of the planter. In addition, stabilizing plates for the planters were designed so that the tie bar connecting the two planters would be more effective as a stabilizer. Lack of cooperators in the 1958 season prevented the field testing of these modifications.

The 1958 season, enforced by similar observations in previous years pointed out the need for a planter which would be both accurate and which could be towed behind any kind of tractor. All present special designs and modifications in use require the use of a tool bar tractor at a time when tool bar tractors are not generally available because of pressing field work. This frequently results in inter-row grain being planted later than it should. In view of this, work on the design of a new type planter was begun. This planter would be a sled type about 2' wide with adjustable side plates or "wings". These side plates would ride on the sides of the asparagus ridges thus centering the planter. The distributor mechanism would be driven by a spiked, gravity loaded drive wheel following the sled. Distributor and openers would be of standard grain drill design modified to allow a low center of gravity. The forward end of the sled would be

fitted with a small tool bar for the attachment of furrowing disks, chisels, weed knives, etc. Having no wheels, it would have to be transported from place to place by truck but could be pulled in the field by any type of available tractor including asparagus jitney "Cubs".

Wind Breaks

Bamboo. The bamboo (P. bambusoides) grew only slightly in height during the 1958 season although it put out much new growth and became generally much more vigorous. Perhaps the poor showing in added height resulted at least partially from the poor vigor last year caused by droughty conditions. Another factor may have been damage resulting from an amino triazole spray late in the winter (February 17, 1958) used to control a heavy growth of annual grasses in the bamboo strip. Although care was exercised to keep the spray from the bamboo foliage, the bamboo exhibited severe amino triazole symptoms a month later. Some plants were bleached almost completely white while many culms, particularly those from severely affected plants had little green pigment in the new growth. Two months after the spray was applied many new culms were showing moderate to severe amino triazole symptoms. Three months after spraying, severe symptoms continued to show on only two plants.

By the end of June, sixty-six new shoots or culms had been sent up, most of which were as tall or taller than the parent plants. The increase in height of the 26 parent plants due to the new growth is shown below:

	March 1958	October 1958
Number of plants shorter than 3'	11	4
Number of plants 3' high	4	2
Number of plants taller than 3'	11	20
Average height (ft.)	3	4.1
Tallest plant (ft.)	5	6

Although the increase in height of the bamboo was discouragingly small, the large amount of new growth greatly increased the density of stand. This rapid spreading tendency (many of the new culms arose several feet from the parent plant) would indicate that initial plantings of P. bambusoides for windbreaks could utilize wider spacings between plants than the 7' used in this planting. By the time the bamboo has grown tall enough to be an effective windbreak, it would have spread sufficiently to fill in a considerable space between initial plants.

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In order to avoid the possibility of plant set back due to drought (as was experienced in 1957), the plants were irrigated regularly according to need from May 15 to October 6. Despite the exceedingly wet spring, the soil at the bamboo site was dry to a depth of 8" by May 15 and only below 12" was there ample moisture. At no time during 1958 did the plants take on the dry, unthrifty look which they showed in 1957.

Since the hardy timber bamboos (of which P. bambusoides is one) spread and reproduce by sending out long shallow rhizomes in the late summer and fall, the problem of keeping the windbreak within its boundary comes up. So far this has not been a problem in the present planting since normal disking of the adjacent asparagus has either killed the new rhizomes as they grow into the cropping area or has killed any new culms which have arisen from excised but mature portions of rhizomes. As the plants and the rhizomes get larger, it is not known whether ordinary disking will suffice to control the spread of the bamboo. There is some evidence to indicate that if the rhizome is cut from its parent plant at an appropriate time in the fall, it will not be sufficiently mature to send up any culms the following spring and will die. If it is excised too early in the season the portion still attached to the parent plant will send out new rhizomes from lateral buds. If the proper time for cutting the rhizomes could be found, a tractor mounted cutting blade or chisel used once or twice a year might be sufficient to contain the bamboo within its boundaries.

Preliminary work on this idea was done in the fall of 1957 but could not be followed through in the spring of 1958. All excised rhizomes extended into the cropping area and could not be found in 1958. They had been either moved or destroyed by the normal cultivation of the adjacent field. In the fall of 1958 a more comprehensive series of rhizome cutting was set up. Altogether, 31 rhizomes were cut or marked for observation. Cutting was done at monthly intervals from the first of October to the first of December and on September 15. All cut rhizomes extending into the cropping area were removed and replanted within the bamboo plot. Evaluation of these treatments will be made during the spring of 1959.

A hard frost (24°F. on an island adjacent to the bamboo plot) over the weekend of November 15-16 severely damaged the foliage of the bamboo with an average of perhaps 90% of the foliage killed. It is not known whether the small branchlets and lateral buds from which new foliage grows in the spring was damaged or not. A few unseasonal young culms were killed. How much damage the plants sustained is not known. Previous frosts do not seem to have seriously hurt the plants. Tall mature plants believed to be the same species but growing on levees of the islands in the delta were not affected by the frost. The literature indicates that these plants should be hardy down to 6° F. Perhaps as the plants become larger they will take on more frost resistance.

<u>Other windbreak material</u>. Arizona Cypress. Arizona Cypress was originally grown in the Christmas tree variety trial plots. In 1957 it was determined to be unsuitable as Christmas tree material. Its tall thin nature, however, suggested its possible use as a windbreak tree so it

was left in the plot for observation. By the end of 1958 the better trees were 11' to 12' high and about 4' in diameter and appeared promising for windbreak use. Their rate of growth and general characteristics will continue to be followed.

Poplar. There are only a very few of these left in the delta as windbreaks because of their disfavor among farmers. One such windbreak was observed during a wind of about 18 mph. The wind caused the folding of branches and leaves to such an extent that the windbreak appeared to have a density of only about 35%.

New Crop Possibilities

As has been mentioned in previous reports, 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. They will be reported upon briefly here.

Christmas tree variety trial. Stump cultures of Monterey Pine cut for Christmas trees in 1957 grew at a satisfactory rate in 1958 (some became large enough to be cut for small trees) but tended to be crooked and lopsided. This may have been caused by overcrowding or allowing more than one branch per tree to develop. Monterey Pines turned out to be unsatisfactory on other counts however. Large masses of needles in the interior of the tree died and turned brown, the tops were often not well formed, tender young growing shoots in late fall were either damaged by frost or wilted when the tree was cut, and about half of the trees showed some dying of the outer needles.

Scotts pine put on a large amount of growth during the year but began turning a characteristic brown the first part of December. None of the trees were ready for market.

Douglas fir grew rapidly during the year and remained healthy looking with good color and form. The tallest trees were 4½' high and might be marketable in 1959. Of all the varieties tested, Douglas fir presently appears to be the only one suited to Christmas tree production in the delta.

Blueberries. A new plot was established on Terminous Tract and gave promise of being highly satisfactory. All plants previously growing in the Hindge Tract plot were transferred to Terminous on March 26th. They were set out at modern commercial spacings (10' rows, 5' spacing in rows) and planted into the bottom of 10" furrows. The latter was to allow a continuous leaching of salts during irrigation and to act as a hedge against future subsidence of the land. These plants were given excellent care throughout the season and grew well, putting out a large amount of new growth. Two distinct foliar symptoms showed up on some of the plants which were believed to be of nutritional origin. Treatments of N, P, K, ferric sulfate, Zn (spray), Zn (soil), Mg, soil sulfur, and 4 kinds of iron sprays were tried singly and in various combinations. One of the deficiencies was found to be iron, treatable with an iron-Urea spray with

wetting agent. The other deficiency has not been determined.

One blueberry cooperator planned to put in about an acre of commercial blueberries based on the apparent success of the blueberry variety plot on his land. A shortage of available planting stock and the exceptionally wet conditions and floods of the spring postponed the planting to another year. Extensive soil sampling of the proposed planting site revealed a highly variable salt situation. E. C.'s were found running all the way from 0.50 to 6.8 milli mhos for the saturation extract. Two holes only one foot apart could vary as much as 4 fold in their saturation extract conductivity. The cooperator was advised to thoroughly leach the site before planting blueberries.

By mid-April 2/3 of the plants in the Mandeville plot were showing symptoms of reddening of the tops of the leaves and a curling, buckling, or cupping of the leaves due to uneven growth. Soil and leaf samples were taken. Saturation extract conductivities ran 0.25-0.61 milli mhos, ruling out excessive salt as the cause. The cause was not determined.

Two of the plots suffered from lack of sufficient irrigation in the fall, one of them seriously. At least 12 plants were lost due to the droughty condition in September and October.

Irrigated pasture. No experimental work was done with the Hindge pasture in 1958. The cooperator continued to feed bluestone in the drinking water whenever the cattle were not being offered supplementary dry feed (screenings). They remained healthy and continued to put on high gains. Although enthusiastic about the future of cattle production in the delta, the cooperator feels that the ever present threat of flood and loss of cattle in the winter is a problem to be considered by any potential peat land cattle grower. All cattle were removed at the end of the year and the pasture dug up in preparation for the planting of asparagus.

The local Farm Advisor has been working with another delta grower who successfully planted and stocked irrigated pasture during the year. Supplemental copper feeding has not been necessary.

Observation of the Coastal bermudagrass plot planted in the fall of 1957 indicated that it was not a "tough" plant and when young could not compete with local weeds under delta conditions. Between spring weed growth, hand mowed twice, and two accidental passes of a disk over the plot, the Coastal bermuda was completely killed. It would stand a better chance of survival in particularly clean fields.

Extension Service rice plots in peat soil confirmed the results of similar trials in the past. Although the rice grew tall and rank, the heads did not fill out resulting in very low yields. This was grown as dry land or non-flooded rice. For purposes of minimizing subsidence, flooded rice would seem to be most useful in the organic soils of the delta. Rice growing should be tried again as flooded rice if at all possible.

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Subsidence

Rindge. In cooperation with Clyde Houston, Extension Irrigation Specialist, Davis, the second of a series of elevation measurements was taken. Two years' measurements are insufficient to show any significant trends. Although this traverse is roughly only one fourth as long as the Lower Jones, Mildred, Bacon Island traverse begun by Walter Weir in 1922, it was found that detailed changes in elevation throughout the traverse from one year to the next cannot be detected with any reasonable degree of certainty. The problems of maintaining instrument level in the soft peat ground and of determining the normal surface elevation in different fields with many degrees of tilth, macro roughness (potato and asparagus ridges), and compaction prevent the necessary accuracy. On the basis of this experience, it is anticipated that the Rindge traverse will be run only every second or third year.

Lower Jones, Mildred, Bacon Islands. The continuing measurement of the elevation along a traverse on these islands which was set up in 1922 by Walter W. Weir, Drainage Engineer Emeritus, California Agricultural Experiment Station, California, became the responsibility of this project. The traverse was run again April 29-May 1, 1958. The following table includes the last two measurements, all previous years having been published in Hilgardia, Vol. 20, 1950, pp 37-56.

Below sea-level elevation, in feet

Year	Lower Jones Tract	Bacon Island	Mildred Island
1955	11.90	12.44	11.32
1958	12.43	12.99	11.67
Total subsidence in 36 years	7.36	9.36	9.64
Average annual subsidence	0.20+	0.26+	0.26

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Soil Temperature Measurements

As a complement to oxidation studies of peat soils being undertaken by Dr. Francis Broadbent and for the purpose of making possible the extrapolation of such studies to field conditions, peat soil temperatures were measured throughout the year. Autolite thermographs with 7-day charts were installed in a field on Rindge Tract. Temperature sensing bulbs were pushed horizontally into undisturbed soil at depths of 4" and 12". The surface above the sensing bulbs was maintained free of weeds and no irrigation or cultivation took place. Yearly highs of 79°F. at 12" and 92°F. at 4" were recorded. Lows were 54°F. at 12" and 42°F. at 4". From the data obtained, any desired summation or averages of temperatures may be obtained for the purpose of estimating oxidation rates in the field from laboratory determined rates with the same soil.