Irrigation and Drainage Letter

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WASTE WATER STUDY IN SAN JOAQUIN VALLEY

A. F. Pillsbury

(Being conducted by Department of Irrigation and Soil Science, U. C., under auspices of University's Water Resources Center)

The term "drainage" is used to describe the removal of surplus (unwanted) surface waters and of excess subsurface or ground waters. The surplus surface waters, through flood control storage measures, are mostly being utilized--becoming waters required for the increased acreage of irrigated agriculture. The excess ground waters--those close enough to the soil surface to cause salinity problems--are the real problem waters. They can ruin the agriculture of overlying land and they can degrade downstream supplies. They, in general, are waste waters which must be removed to keep the land in intensive agriculture and must be separated from irrigation supplies.

Drainage systems cannot be properly designed without knowledge of what the quantity and quality of such waters might be. Plans for separation and ultimate removal or reclamation of such waters cannot be made without that same knowledge. It is the purpose of this project to establish yardsticks to better estimate the quantity and quality of such waters, and, in addition, to determine how such separation might satisfy the future salt balance requirements of closed basins.

Initial efforts are being directed towards a study of 20 existing shallow subsurface drainage facilities (drain tile and ditch drainage systems) to determine the means and peaks of yield and quality and to evaluate the various parameters which affect such yield and quality. Procedures are:

1. Mapping. Each subsurface drainage system studied is being mapped to show the physical system and the soil classification. Pertinent information is also tabulated to characterize the cropping and irrigation practices, etc.

2. Metering and sampling. Periodic effluent metering is undertaken; continuous metering has been undertaken at 5 sites (with periodic shifting of equipment as each site becomes characterized.) Frequent field sampling is for total salts (EC); less frequent field sampling for EC+SAR; infrequent field sampling is for complete laboratory analysis. Sites were selected where metering and sampling can be carried on (outlets not submerged, etc.)

3. Application. As much information as practical on quantity and quality of irrigation water applied is obtained. Amounts and dates may be estimated from District deliveries farmer records, etc. Quality is checked by periodic EC determinations, and sometimes EC plus SAR. It is assumed that more complete information on quality can generally be obtained from other organizations.

4. Subsurface water movement. It is anticipated that, as the work progresses, it may be possible to obtain information on the nature of subsurface flows and relate these to such things as soil classification, core drillings of the Department of Water Resources, and hydraulic conductivity measurements. In this, there may be determinations of mid-point recession rates, lateral flow components, and natural drainage.

5. Salt Balance. In arid and semi-arid regions, the adequacy of subsurface drainage facilities is gauged by their ability to

maintain a salt balance in the soil root-zone at some level which permits a profitable utilization of the land. Some information will be available from the application - effluent quality relationships. This will be supplemented by periodic sampling of the soil for ECe and SAR, possibly twice a year at prescribed times.

6. Relation to drainage theory. Field data will be checked against drainage theory to determine the adequacy of that theory.

Field work on this project was initiated on February 1, 1959 by Mr. William R. Johnston, Assistant Specialist of the Irrigation Department. The Soil and Water Conservation Research Division, ARS, USDA (Mr. Leonard Schiff, Research Project Leader) 4816 E. Shields Avenue, Fresno, has made space and facilities available to Mr. Johnston.

REPORTS FROM COUNTIES

Butte County - Meith - August, 1959

My work on almond, citrus and olive irrigation this summer has been most informative both to me and to the growers I have been working with. Twice each week through the spring and summer I have informed cooperators as to what the moisture situation is in their orchards as determined at the test tree. More than once it was necessary to put an auger to work to show a skeptical cooperator that his soil was just as dry as the instrument showed it was. By now each of the cooperators is completely sold on the value of instrumentation in improving his irrigation practices. Several want more reading stations in their orchards next year. I don't believe I have worked with anything that has aroused as much interest with growers as this irrigation work. Delbert Birdseye says that this is the finest service he has ever had.

Before the next irrigation season rolls around the information gained will be presented at grower meetings.

Fresno - Sarquis - August, 1959

With rainfall below normal last winter and prospects for a relatively dry winter coming up (based on long range forecasts), the water situation has been and may continue to be quite critical. From time to time we hear of wells having to be deepened or bowles lowered.

In view of heavier pumping this summer and the possible future situation, a number of the larger westside growers have met and agreed that during the five month period following completion of cotton irrigation they will not operate their pumps for 90 continuous days. The 90 days may be selected at the grower's discretion.

This agreement, we understand, will terminate Feb. 1st or March 1st. The attempt is to conserve water for the next pumping season.

We are certain this will not affect cotton pre-irrigation but may affect barley acreag and will affect the practice of winter irrigation of seed alfalfa. This could seriously affect next year's seed production and new plantings.

Knowledge of this agreement is not first-hand from the parties involved but we should keep apprised of the situation.

Kings County - McCutcheon - October, 1959

The data from a safflower variety trial harvested in August has been tabulated. This was a cooperative trial carried on with the help of Dr. Knowles of the Division of Agronomy and Roydon Edwards, Field Crop Technologist, Agricultural Extension Service, plus the cooperator Charles Schwartz. The test was a good one and met with considerable praise. Harvesting was made possible by the cooperation of the cooperator who ran his harvester throug the varieties and then allowed us to weigh each variety separately. Yields were as follows:

Pre-Irrigation Only:

Variety	#/Acre	#/Bu.
BC6	3680	42.4
N-10	3400	42.8
Gila	3350	43.2
Pac. 1	3330	42.0
Pac. 7	3220	41.4

No significant difference between varieties at the 5% level.

A second trial consisted of the same varieties but they were irrigated three times; one pre-irrigation, and two post-irrigations. Yields from the irrigated plot showed considerable variations and are as follows:

Gila	3190
N-10	2960
BC6	2870
Pac. 1	2600
Pac. 7	1580

291.2#/acre difference is significant at the 5% level.
All varieties are significantly better than Pac. 7.
Gila significantly better than BC6, Pac. 1 & 7.
N-10 significantly better than Pac. 1 & 7 but not BC6. BC6 significantly better than Pac. 7 but not Pac. 1.

Here, as in other areas, safflower's susceptibility to root diseases was noted when post-irrigations are applied. The yield in every variety that was irrigated was reduced.

Commercial yields ran an average of 3200 pounds per acre. With a price of $75.00 per ton guaranteed, this crop can compete with barley. A meeting on safflower has been held. Results of our tests have been disseminated. Interest in growing safflower seems fairly good. However, I don't recommend the crop except on the deep soils of Tulare Lake area.

Mendocino County - Bearden - December, 1959

In the past several years I have come to feel that proper handling of irrigation is the key factor in getting the most out of a pear orchard. I feel that great strides could be made in improving crop quality and total tonnage through better management of water and that too much time is being spent on other things such as fertilizers and micronutrients, spraying, pruning, sub-soiling, etc. while the key factor to the whole thing - irrigation - has not been sufficiently emphasized or worked on in relation to its importance.

Merced County - Stewart - August, 1959

Weekly water table readings are being taken at the Pirrone vineyard to determine the results of the tile line laid in June on the underground water situation in the adjacent fields. A further check of the pumping effect is now being made. The pump was silenced on August 19 and will not run again until September 9.

The 10 test wells will be read on August 25 and September 1 and September 8 to evaluate the natural water table situation. Pumping will then resume and weekly readings will continue. These readings will later be charted and the project written up.

Modoc County - Bedell - September, 1959

Two days were spent conducting border irrigation field trials on the Weber and Caldwell ranches. Both of the fields were in grain stubble and will be planted to hay crops next spring. The important things determined by these tests were the amount of water applied per acre and the length of time to leave it on for the most effective irrigation for given soil and crop conditions. Both of these fields were surveyed by Carl Rimbey and serve as demonstration areas.

Fourteen days were spent on land leveling projects. Considerable interest has been shown for this type work in Modoc County. It is hoped that some of the fields leveled with Extension assistance can be used as demonstration plots for the proper management of land and water.

Tulelake - Baghott - September, 1959

The leaseland drainage study project, carried on jointly with the University of California Irrigation Department, Tulelake Farm Advisor and the Bureau of Reclamation has been completed. A publication is now being prepared by the Irrigation Department and the Farm Advisor. The study involves the use of tile drains for the reclamation of saline soils. The results of the study indicate how serious salinity has become in the Tulelake Basin and what can be done to correct the situation. Cooperative people from the

University, on this project, are Doctors James Luthin and Jim Biggar of the Irrigation Department at Davis; Farm Advisor Baghott, Tulelake and Dave Bunger of the U. S. Bureau of Reclamation, Klamath Falls, Oregon.

Two days were spent in the field with Luthin and Biggar obtaining the last soil samples from the drainage plot and taking out the water stage recorders. The test pipes and wells were pulled. This piece of work, I think, is one of the most interesting and valuable pieces of work attempted by Extension and University for the area and will be of great value to farmers throughout the State.

Monterey County - Lugg - September, 1959

The vegetable crops growing in the lower Salinas Valley, particularly the Blanco District, have suffered from salinity severely this past year. One of the larger vegetable companies solicited our help in studying the causes of this salinity and we were able to outline a program which this vegetable company should follow to determine the causes of the salinity. In a month or so when they have gathered the necessary data, I will meet with them once more to make recommendations. If this company does any drainage work or improvement of irrigation practices, it will be a great accomplishment. The area mentioned is an unusual one soil wise. The surface soil is fine sandy loam while the sub-soil is heavy black clay.

Placer County - Johnson - October, 1959

Estimates of future water requirements for the valley area of Placer County are nearing completion. A few minor details need to be ironed out, and then a report will be prepared. I met with three representatives of the engineering firm working on the Placer County Water Agency's proposed project. The meeting was to review the material prepared to date on estimated future water requirements. The engineers were most appreciative of the opportunity to see and review the information we have. It is entirely possible that this information will be submitted at future water rights hearings.

Discussions have been held with personnel of the State Department of Water Resources to consider making a final review of land use, land classification, and water diversion studies made in portions of Placer County the past two years. Such a review, to be made by the Placer County Water Agency and local committees, is scheduled for January 6.

Plumas County - Rimbey - September, 1959

Arrangements have been made to lay out an irrigation demonstration plot on the meadows of the Van Vleck ranch near Sattley. This project is being started to show the people of the area that it is possible to do a job of renovating these meadows and by doing a good job they can increase their production at least four times. This ranch is now producing gains of 70 to 90 pounds per animal on yearling steers. It is necessary to get it to not only produce more feed but feed that is of higher quality.

Sacramento County - Carlson - October, 1959

Gordon Morehead and I managed to make considerable progress on our county seepage study this month as we were able to obtain the location of some observation wells which have been used by the Department of Water Resources. Description of 57 such wells along the Sacramento River from the north county boundary to Isleton were obtained. 41 of these wells were in Sacramento County and we were able to locate and use 34 of them. Adding these to the 30 to 35 wells established by growers gives us a fairly good coverage of the water ways in the county. We still plan to establish 15 or 20 more county wells to fill in any gaps not covered by those already being measured. We will be able to start our monthly measuring program on the first of December.

Shasta County - Spivey - August, 1959

I attended two different meetings regarding hydro development of the McCloud River. The first meeting the P. G. and E. and California-Oregon Power Company stated why their company should develop

the river. Each presented strong cases. At the second meeting the company officials. were not invited. The water agency directors discussed the cases that each power company had presented at the previous meeting. The directors endorsed the P. G. and E. proposal.

Essentially the plan calls for one fairly large dam on the McCloud. Water will go through a tunnel to two small reservoirs and thence through hydro plants and the water dumping into the Pit River above proposed pit 6 and 7 powerhouses. The McCloud dam should be completed within three or four years and pit 6 and 7 within ten years. The completed project will cost about 90 million dollars--about 325,000 kilowatts of power will be produced.

Siskiyou - Maxwell - August, 1959

Work is being continued on water needs for agriculture, industry and recreation. The Department of Water Resources is becoming much interested in our committee recommendations and has revised their estimates upward.

Stanislaus County - Meyer - September, 1959

A meeting was held in conjunction with Paul La Vine's grape meeting to demonstrate how tensiometers can be used in vineyards and also how to construct them on the farm. Response to this meeting was so large that I felt it necessary to write a leaflet on installation and construction of these instruments. It is quite apparent that a number of growers are now ready for irrigation control in vineyards. This has been a long time coming. In many areas the high water table was such that irrigation control was impossible. This year, however, with all pumps in the County running continuously, the water table has virtually dropped out from under the whole area. I plan to cover this phase of irrigation again at the fruit school and in grapes again later in November.

Yuba County - Fox - September, 1959

The information gathered from the installations of gypsum blocks in this county and in Sutter County this year will be very useful in making recommendations to the farmers concerning their use. From the data gathered, it seems that these blocks can be very useful to the farmer in scheduling irrigations. There have been several farmers that have expressed interest in obtaining blocks to use on their farms next year. Because of this, George Post of Sutter County and I feel that it might be to our advantage, as well as the farmers, to write a county bulletin on the use of the blocks. We plan to write this sometime this fall.

People in the foothills are becoming more interested in sprinkler systems. A great deal of time was spent this month assisting one farmer with a new sprinkler system in connection with an FHA loan he was applying for. This involved installing a weir in a small stream to determine the amount of water he had to work with in addition to that which he buys from the irrigation district. In this district there is not enough water for everyone to completely irrigate his farm so an installation such as this one required initial and ultimate planning so that the part of the system used initially can be integrated into the ultimate system. This will be the general rule until the district develops its anticipated new supply.

As was indicated in last month's report, this office felt that it was necessary to prepare a publication to aid the farmers in determining whether or not they wished to bring in surface water from the Yuba River in place of pumping water from underground. Considerable amount of time was spent this month in preparation for this bulletin. Assistance was received from the Pacific Gas and Electric Company, a local pump company and data from the County of Yuba and State Department of Water Resources. The bulletin consisted of an indication of the fall of the ground water table of pumping costs to allow the farmer to estimate how much it is costing him to pump his irrigation water at the present time. The information in this bulletin will be disseminated at various meetings throughout the county to be held by the Board of Supervisors

and their water engineer at which meetings I will be present. An honest evaluation by the farmer himself of his own situation will be the only thing that can make the project succeed. It is our aim to provide information to the farmer so that he can make this decision.

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File Number 12:16

GRAIN SORGHUM IRRIGATION TRIALS

Davis, 1959

By
D. W. Henderson

Influence of Early and Late Drought on Seed Development and Yield

Objectives and experimental conditions:

Because of rapid extension of roots of grain sorghum into moist Yolo subsoil it is ordinarily difficult to obtain severe drought conditions at Davis. However, low rainfall and lack of spring rains gave us a rare opportunity this year. A volunteer barley crop (with some vetch) was permitted to grow until late May. This crop removed all of the available soil moisture to a depth of 5 feet and reduced moisture to low levels to a depth of 7 feet. The barley was removed, 150 lb./A nitrogen broadcast, and sufficient water applied by sprinkler to rewet only the top 2 feet of soil. The seedbed was worked and RS 610 planted in 30" rows on June 11. Except for wet treatment, water applied per irrigation was 4". The general objective was to compare moderate and severe drought both early and later in the season with a treatment amply supplied with water throughout the growing period. Because of large differences in maturity, all mature heads were harvested on two different dates.

Treatment descriptions:

Treatment 1 (wet) Irrigated every 10-12 days beginning about 4 weeks after planting. Irrigated 7/13, 7/24, 8/4, 8/14, 8/25, 9/4.

Treatment 2 (wet early - dry later) Irrigated twice early at same dates as treatment 1. Later irrigations moderate as drought symptoms appeared. Irrigated 7/13, 7/24, 8/7, 9/3.

Treatment 3 (wet early - very dry later) One early irrigation, later irrigations at "firing", Irrigated 7/13 and 8/14.

Treatment 4 (dry early - wet later) The first irrigation delayed until moderate drought symptoms appeared, then irrigated every 10-12 days. Irrigated 7/20, 8/4, 8/14, 8/25, 9/4.

Treatment 5 (very dry early - wet later) The first irrigation delayed until "firing", then irrigated every 10-12 days. Irrigated 7/27, 8/7, 8/18, 8/28, 9/9.

Note: 1.8 inches rain on 9/18.

Treatments 1, 3, and 5 have been applied to plots of DD Yellow Sooner. It was planted on June 13 and with minor deviations, irrigations were applied on the same dates as on RS 610.

Tillering, head size, and seed size will be evaluated as well as final yields. Only yield data are now available. (See table)

Yields of RS 610 and DDYS, Davis, 1959

Irrigation Treatment	1st harvest1/	2nd harvest2/	Total
	RS 610		
1	7627	-	7627
2	7029	-	7029
3	2844	1148	3992
4	2418	4058	6476
5	1088	5224	6312
	Double Dwarf Yellow Sooner		
1	6287	--	6287
3	2074	798	2872
5	3106	1726	4832

1/ Oct. 7 (118 days after planting) Harvest time selected when treatment 1 had just matured; treatment 2 was judged ready for harvest about 5 - 7 days earlier.

2/ Treatments 4 and 5 harvested October 27 (138 days); treatment 3 harvested November 11 (153 days).

Discussion:

The experiment demonstrated some very interesting responses. Early drought (see treatments 4 and 5) resulted in moderate yield reductions but very pronounced delays in maturity. Under conditions of the experiment it proved impossible to have a period of moderate stress; when the available water had been removed from the top 2 feet of soil there was no available water at all. The principal difference in treatments 4 and 5 was that treatment 5 plants were in a severe drought condition for 10 to 12 days and in treatment 4 for 3 to 5 days. Treatment 5 lost most of the lower leaves. The recovery of the plant at this state is one of almost complete regrowth with considerable tillering.

Treatment 3 plants "fired" the second week in August while the heads were in the boot or just emerging. Severe blasting was apparent on both varieties when heads emerged following irrigation; but the blast appeared much worse on RS 610 than on Yellow Sooner. When a head blasted severely, two branch heads formed later, resulting in two distinct crops. The later crop (see yield data) was probably too late for harvesting under most farm conditions.

It shouldbe remembered that the plants were subjected to very severe drought in the boot stage. Previous experiments indicate that moderate drought at this stage has little effect on final seed yield. The boot stage should be considered "critical" in that it is essential that the plants have some available water in the root zone, but not "critical" in the sense that an irrigation must be applied just before the boot stage.

Treatment 2 essentially confirms results of earlier experiments. Moderate drought, or drought of short duration late in the season, reduces yeilds only slightly or not at all and tends to produce crops of slightly earlier or more uniform maturity.

Influence of Subsoil Conditions on Root Extension, Growth and Yield

Objectives and experimental conditions:

In Yolo soil, large amounts of soil moisture are made available to grain sorghum by rapid extension of roots into moist subsoil. On poorer soils, root extension is slowed down by mechanical impedance, making subsoil moisture available much more slowly. A trench 12' wide and 130' long was excavated to 3 feet depth and backfilled with a carryall. The soil was moist (F.C.) when excavated and was compacted by backfilling in thin layers with each layer passed over several times with crawler tractor and loaded carryall. About 6 inches of loose, dry soil completed the backfill. This strip and an adjacent undisturbed strip were planted to RS 610 on June 8 after sprinkler preirrigation and application of 150 lb./A nitrogen. The sprinkler preirrigation was inadequate and two additional sprinklings were required for germination. Both strips received a furrow irrigation on July 6, after which differential treatment was started, applying water in basins. Compacted and non-compacted plots of the same treatment received the same amount of water on the same dates.

Treatment descriptions: (1.8 inches rainfall 9/18).

Treatment 1 (wet) Irrigated every 10 - 12 days. Irrigated 7/6 (furrow), 7/18, 7/30, 8/10, 8/21, 9/1, 9/14.

Treatment 2. Irrigated both compacted and non-compacted plots when moderate drought symptoms are apparent in non-compacted plots. Irrigated 7/6 (furrow) 7/30 and 8/21. Actually the irrigation applied on 7/30 was put on before any drought symptoms in the non-compacted area to avoid complete loss of drier plots on compacted area, which had fired very badly.

Sorghum Yield in Relation to Subsoil Compaction and Irrigation Treatment

Treatment	Yield
	Non-compacted subsoil
Wet	6098
Dry	5151 (84% of wet)
	Compacted subsoil
Wet	4919
Dry	2178 (44% of wet)

(Harvested November 29)

Discussion:

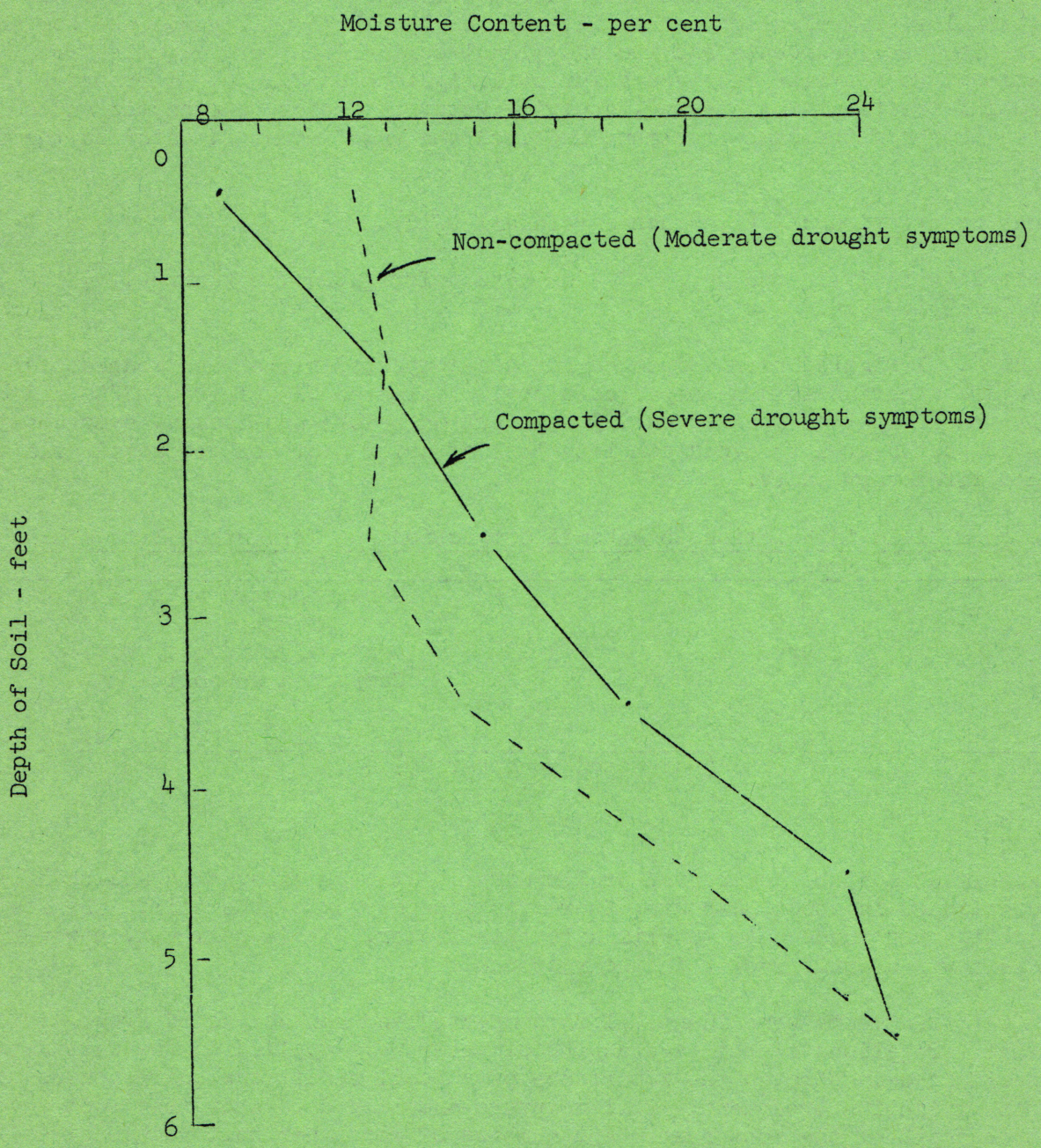
This experiment must be considered preliminary. Although excavation and backfilling was accomplished in about 30 hours, there was some drying of the soil. The shallow preirrigation was inadequate to eliminate this factor. It is believed, however, that this effect was a small factor in the response.

Dry and wet treatments were identical on compacted and non-compacted areas, in the sense that irrigations of the same depths of water were applied on the same dates. The experiment demonstrates the importance of subsoil conditions on responses of plants to irrigation treatment. Soil moisture sampling data show that root development (both depth of the root system and numbers of roots per unit volume of soil) is retarded by the dense subsoil. The per cent moisture remaining at different depths in the soils of the two dry treatments on August 20 is shown in the accompanying graph. On that date the plants in the non-compacted treatment were just beginning to show moderate drought symptoms, while those on the compacted plots had exhibited

severe drought symptoms for several days prior to sampling. However, except for the top two feet, there was considerably more residual available moisture in the compacted soil. This effect should occur if the physical condition of the subsoil retards root development, regardless of the cause, and therefore might be expected on naturally dense or tight subsoils.

Maturity was seriously delayed by the dry treatment on compacted subsoil. All plots were harvested later than would be practical in farming operations. If harvest had not been delayed, yield of the dry compacted treatment would have been much less.

Residual Soil Moisture in "Dry" Treatment on August 20, 1959
RS 610 Sorghum. Davis



Plants on non-compacted plots showed only moderate drought symptoms. Plants on compacted plots had shown severe symptoms for several days although there was considerably more "available" moisture remaining.

File Number 12:16

GRAIN SORGHUM IRRIGATION TRIALS

Five Points Field Station, 1959

By
D. W. Henderson and D. G. Smeltzer

Objectives and experimental conditions:

The principal objective was to determine the influence of a wide range of irrigation frequency (and number of irrigations) on seed development and yield on the deep Panoche clay loam soil of the Five Points Station under climatic conditions somewhat more severe than that at Davis. Three varieties were planted (R.S. 610, R.S. 660 and DD38) as subplots in irrigation treatment plots. Each plot formed an irrigation basin and each irrigation presumably rewetted the entire root zone even though water penetration into the soil was slow. Because of the long growing season, plantings were made on May 4 and July 3. Row spacing was 36 inches for all plots. Approximately 100 pounds nitrogen was applied per acre.

Treatment descriptions: (All plots thoroughly preirrigated)

Wet. Eight irrigations. The first irrigation applied about 4 weeks after planting with later irrigations at 8 to 10 day intervals.

Medium. Four irrigations. The first irrigation applied about 4 weeks after planting with later irrigations at 17 to 20 day intervals.

Dry. Two irrigations. The first irrigation about 5 weeks after planting and one additional irrigation about one month later.

Yields of Grain Sorghum, Five Points, 1959

Irrigation Treatment	R.S. 610	R.S. 660	DD38
	May 4 planting (Harvested September 10)		
Wet	6257	5979	6738
Medium	6652	6278	6577
Dry	6226	6465	6727
Average	6375	6241	6681
	July 3 planting (Harvested November 4)		
Wet	5253	5296	4922
Medium	4880	4898	4672
Dry	5040	4933	5061
Average	5058	5042	4885

Discussion:

There are no important differences in yield due to irrigation treatment for any variety on either planting date. Soil moisture samples taken from the dry plots at harvest showed some available moisture remaining although the last irrigation had been applied some 70 days previous. It appears possible that very respectable yields may be obtained with one irrigation after thoroughpreirrigation. However, in these tests there was some difficulty in stand establishment and young seedlings suffer from drought unless there is moisture in the surface few inches of soil.

The data indicate that better yields may be obtained if planting as late as July is avoided.

File Number 12:16

GRAIN SORGHUM IRRIGATION AND SPACING TRIALS

Slaughter Plots - Tulare County, 1959*

General description:

The sorghum (Variety) was planted on 40-inch beds June 17. The plot area was fertilized with 80 pounds nitrogen per acre. Four irrigation treatments were applied with four in-row plant spacing treatments for each of the irrigation treatments. Plant observations indicated early boot stage on August 13, 50 to 90 per cent heading on August 24 and late flower to early kernel fill stage on September 8. Gypsum resistance blocks were used to indicate soil moisture conditions.

Treatment description:

Spacing treatments are designated by the equivalent average distance between plants in a single row on 40-inch beds. In an unthinned treatment the distance was 0.9 inches; in thinned plots the spacings were 1.5, 3 and 6 inches. The plants were 8 to 10 inches high at thinning.

Irrigation treatments were as follows:

A treatment - 2 irrigations on 7/22 and 9/10.

B treatment - 1 irrigation on 8/13. (This treatment showed obvious moisture deficiency symptoms on 8/3.)

C treatment - 3 irrigations on 7/22, 8/13, 9/10.

D treatment - 3 irrigations on 7/22, 8/29, 9/10.

Grain Yields - Irrigation and Spacing Trials - Tulare County
(adjusted approximately to 15% moisture)

Irrigation Treatment	In-row spacing - inches between plants				
	0.9	1.5	3.0	6.0	Average
A (2)	4758	5586	5201	4722	5067
B (1)	4931	4927	4221	3568	4412
C (3)	6865	6257	5848	5107	6019
D (3)	6142	5998	5778	4933	5713
Average	5674	5699	5262	4582	

Discussion:

The data indicate that under conditions of this experiment 3 irrigations are necessary for best yields, and point to the possibility that 3 more evenly spaced irrigations (treatment C) are somewhat better than that of treatment D, in which 38 days elapsed between the first and second irrigations, with the third applied only 12 days after the second.

*Experiment was the excellent work of Wilson Pendery and Dick Schade; write-up by Del Henderson.

Yields are definitely decreased as the spacing between plants increases. This is contrary to many observations and experimental results where tillering increases as the population decreases. In this experiment there was no tillering because of variety, climatic conditions, or the late thinning date. A head count was taken at harvest and the number of heads was remarkably constant for all irrigation treatments. The average number of heads per plant was 0.80 for the unthinned treatment and 0.97, 1.03 and 1.08 for the 1.5, 3.0 and 6.0" distance between plants, respectively. One could not expect full compensation for reduced populations without tillering. The calculated average head weight for treatment C, 6-inch spacing is about 5 times that for the same irrigation treatment unthinned!

While it is difficult to make a statement without a statistical analysis, there seems to be no pronounced interrelation between spacing and irrigation.

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Irrigation at Various Stages of Corn Development

By
L. D. Doneen

This study is a continuation of our corn work, reported in the "Irrigation and Drainage Letter" of May 1958, and probably constitutes the last large experiment that will be conducted along these lines for this crop.

In many previous trials, including the previous years experiment, it has been recorded that a relatively high level of soil moisture, which means frequent irrigation, has produced the highest yields. If corn is to compete with other grain crops in this State, it would be desirable to reduce the frequency of irrigation and maintain high yields. Earlier work has indicated that relatively high moisture in the surface soil during the early stages of growth promotes the development of a vigorous root system and contributes to increased yields. This was noted with the late planting of May 29 for the previous year.

The experiment was designed to study the influence of one and two irrigations at various stages of plant development. The plots were on Yolo clay loam at the University of California, Davis. The soil was at field capacity to a depth of 10 feet at planting and the plots were unfertilized. Each treatment consisted of five randomized plots. A summary of the results are given in the following table:

PRODUCTION OF CORN IRRIGATED AT VARIOUS STAGES OF DEVELOPMENT - 1958

Treatment and Stage of Development When Irrigated	Number Irrigations	Ears per Plant	Lbs. per Ear	% Shelled	Yield Tons/A
A - Dry	None	0.95	0.32	74	1.70
C - 10 inches high	1	1.01	0.39	77	2.20
D - 26 inches high	1	1.02	0.43	78	2.40
E - 58 inches high, tassel in boot	1	1.01	0.49	77	2.74
F - 90 inches high, 90% tasseled	1	1.08	0.46	76	2.75
G - Kernel in milk or soft dough	1	0.97	0.46	75	2.23
H - 10 inches high and tassel in boot	2	1.08	0.44	76	2.85
I - 10 inches high and 90% tasseled	2	1.07	0.51	78	3.10
J - 10 inches high and kernel in milk	2	1.11	0.49	78	3.02
B - Ample soil moisture	5	1.09	0.54	82	3.78

The corn was planted late, May 28, so that the surface soil would be relatively dry. Five days before planting, 0.6 inches of precipitation occurred, and with the usual weather conditions for this time of year, the surface several inches of soil would be dry by the time the plants emerged. However, cool and some cloudy weather followed planting with light showers in the early part of June. Consequently, a high moisture condition was maintained in the surface few inches of soil and the early

irrigations, C and D, failed to produce the highest yields for a single irrigation, which had occurred the previous year. The highest yield for a single irrigation was for the E and F treatments when the water was applied after the tassel was developed but still in the boot and after 90% of the tassels had emerged from the boot, respectively. The time between the irrigations for these treatments was two weeks. Otherwise, the general trend is very similar to the results obtained the previous year.

The application of two irrigations, (treatments H, I, and J) one early and the other at later stages of development, showed increased yields when compared to the single irrigation. The highest yield was obtained from the second irrigation when the corn was 90 per cent tasseled, treatment I.

The high soil moisture, treatment B, was first irrigated when the corn was 10 inches high and each succeeding irrigation was at two week intervals. This treatment yielded considerable more corn than the plots with the single or double irrigation.