Computer-Assisted Mapping of Yields in Alfalfa Fields

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Summary

The relative distance between bales in an alfalfa field reflects yield density. Data can be obtained by direct measurement or by aerial photography. A yield "map" can be used to identify areas of high and low yield.

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Establishing a relationship between yield and some soil, water, or tissue measurement is the basis for small research plots, each treated and harvested separately. The correlation between treatment and yield is easily identified. Yield varies naturally within a large commercial field, even where uniform water and fertilizer treatment is intended. The distribution of yield is difficult to document when harvesting is done by conventional means. An exception is alfalfa where the distance between bales is a measure of yield in any area of the field. Where yield is higher the bales are dropped closer together.

Yield data were obtained over a two-year period for a 30-acre field near Coolidge AZ by walking each border with a measuring wheel and recording the distance from the edge to each bale. This took about three hours per cutting. The distances were entered into a computer program which divided the field into 50 x 50 foot blocks, 50 feet being the width of a border. The program calculated and printed the weight of alfalfa in each block, based on a 100 lb. bale. A graphics program created two to four ranges of yield values and printed characters instead of numbers for the blocks which fell into each range.

The result was a yield map for each cutting, showing relatively high and low yielding areas in the field. The boundaries of the ranges were shifted with successive cuttings so that about an equal number of blocks always fell into each range. This permitted blocks to be compared only to others for the same cutting regardless of the overall yield and change in yield from one cutting to the next. Thus the maps for two cuttings over the two-year period are somewhat similar even though the yield for the August 8, 1982 cutting is higher overall than for the May 7, 1983 cutting (Figs. 1, 2). When the yield variation is caused by some inherent or long term soil characteristic successive maps should be similar. Variation caused by a temporary factor such as irrigation water distribution might cause an area to yield high or low for a single cutting. An effect which is confined to a single border, again perhaps water distribution, may show up as in border 7 on the August 8, 1982 map.

A listing of the actual yield for the blocks is useful in conjunction with soil or tissue tests (Fig. 3). Each soil or tissue test value can be correlated with the yield for the block the sample came from. The listing also shows the range of yields over the entire field, information not given by the map. The August and May cuttings gave different yields even though the maps are similar. The yield for the August cutting ranged from 0.5 to 2.5 tons per acre and averaged 1.5. For the May cutting, the range was from 0.3 to 1.4 tons per acre and averaged about 1.0. The distribution of yields from the blocks, best displayed in histogram form (Fig. 4), is important in management terms. The grower, dissatisfied with total yield, may not realize that parts of the field are yielding very well, up to 2.5 tons per acre in August in this field. The histogram shows how much of the field is yielding below an acceptable amount and the data printout and maps help him locate these areas, which he may be able to manage separately from the rest of the field.

Many alfalfa growers would be able to make yield maps and histograms. Data collection requires about an hour per ten acres. Alternatively, a grid could be superimposed upon an aerial photograph and the bale locations recorded with reasonable accuracy. Mapping the yields practically requires a computer with appropriate software.

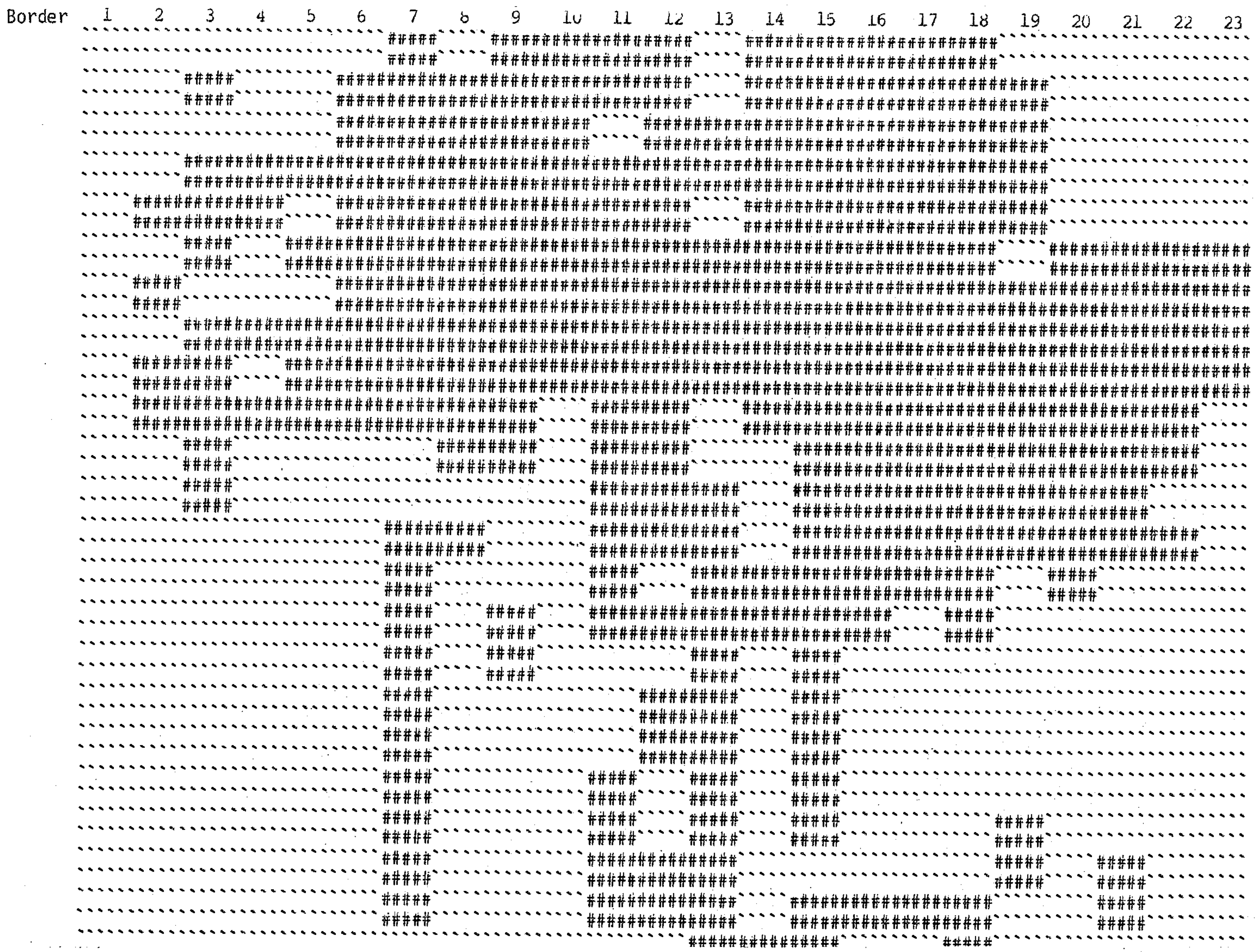

Figure 1. Two-range yield map, August 8, 1982 cutting. Irrigation ditch at top.
(# - yields greater than 1.5 ton per acre, ` - yields less than 1.5 ton per acre)

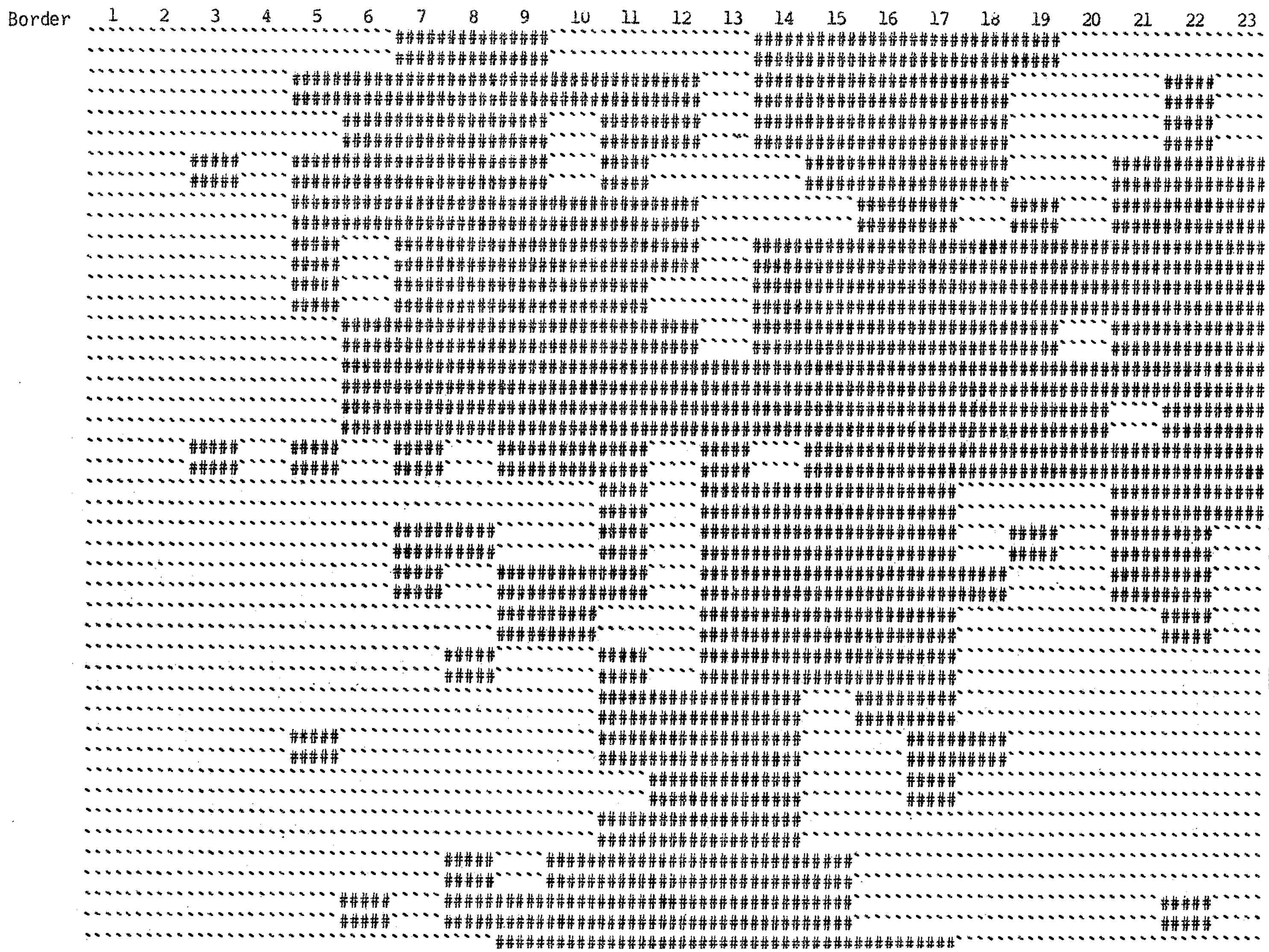

Figure 2. Two-range yield map, May 7, 1983 cutting. Irrigation ditch at top.
(# - yields greater than 1.0 ton per acre, ` - yields less than 1.0 ton per acre)

Border	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	-	-	0.7	0.6	1.2	1.0	1.6	1.3	2.0	2.0	1.6	1.8	1.4	1.6	1.8	2.2	1.9	1.7	1.3	1.4	1.1	1.2	1.2
	1.0	1.0	1.4	1.5	1.2	2.2	1.8	2.2	2.1	2.2	1.9	1.8	1.5	2.0	2.1	1.9	1.9	1.9	1.9	1.3	1.1	1.3	0.8
	0.9	1.4	1.4	1.4	1.2	1.8	1.8	2.0	2.1	1.8	1.5	1.7	1.6	2.0	2.0	2.0	1.7	2.0	1.7	1.3	1.0	1.2	0.8
	1.1	1.5	1.8	1.8	1.6	1.9	2.3	2.2	2.2	1.7	1.7	1.7	1.7	1.9	2.1	1.8	1.9	2.1	1.6	1.4	1.1	1.2	1.0
	1.3	1.6	1.6	1.7	1.4	2.1	1.8	1.9	2.0	2.0	2.0	1.9	1.4	1.8	1.9	1.8	1.9	1.8	1.6	1.5	1.2	1.4	1.3
	1.2	1.5	1.6	1.3	2.4	1.8	1.9	2.0	2.1	2.0	1.6	1.9	1.5	2.0	2.1	2.1	1.8	2.0	1.5	1.8	1.8	1.6	1.6
	1.1	1.7	1.5	1.4	1.3	2.0	1.9	2.1	2.1	1.6	1.8	1.7	1.6	1.8	1.9	1.9	1.9	1.9	2.0	1.8	1.9	1.8	1.6
	1.2	1.4	2.0	1.6	1.6	2.0	2.1	1.8	2.0	1.6	1.9	1.8	1.7	1.8	2.0	1.8	1.9	2.0	1.8	1.8	1.8	1.7	1.6
	1.4	1.6	1.6	1.4	1.5	2.0	2.0	2.1	2.1	1.8	1.8	1.7	1.7	1.7	1.9	1.7	1.8	2.0	1.8	1.8	1.9	1.6	1.7
	1.5	1.ó	1.7	1.6	1.6	1.8	1.9	1.7	1.8	1.4	1.8	1.6	1.5	1.6	1.8	1.7	1.9	1.9	2.0	2.0	1.9	1.7	1.5
	1.5	1.5	1.6	1.5	1.1	1.2	1.4	1.9	2.0	1.0	1.7	1.7	1.5	1.4	1.7	1.7	2.0	2.0	2.2	1.8	2.2	1.8	1.5
	1.4	1.4	1.7	1.0	1.1	1.1	1.5	1.5	1.5	1.0	1.6	1.7	1.9	1.4	1.7	1.7	1.8	1.8	2.5	1.7	1.6	1.5	1.5
	1.2	1.2	1.4	1.0	1.1	1.1	1.6	1.6	1.4	1.2	1.7	1.7	1.7	1.4	1.7	1.7	1.6	1.7	1.6	1.8	1.8	1.6	1.4
	1.5	1.4	1.4	1.1	1.3	1.2	1.9	1.2	1.5	1.4	1.7	1.5	1.7	1.5	1.8	1.6	1.6	1.5	1.5	1.6	1.4	1.5	1.3
	1.2	1.4	1.5	1.3	1.2	1.2	1.6	0.7	1.6	1.3	1.7	1.6	2.0	1.7	1.8	1.6	1.5	1.5	1.4	1.5	1.1	1.5	1.1
	1.3	1.3	1.5	1.1	1.0	1.0	1.6	0.6	1.5	1.2	1.5	1.5	1.5	1.5	1.6	1.4	1.3	1.5	1.3	1.3	1.1	1.4	1.2
	1.4	1.4	1.3	1.3	0.8	0.9	1.6	0.7	1.4	1.3	1.4	1.6	1.8	1.4	1.7	1.4	1.3	1.5	1.3	1.3	1.2	1.3	1.2
	1.2	1.2	1.3	1.2	0.7	0.8	1.6	0.7	1.4	1.4	1.5	1.6	1.8	1.3	1.7	1.4	1.3	1.5	1.4	1.3	1.4	1.3	1.2
	1.1	1.5	1.3	1.2	0.8	1.1	1.7	0.7	1.4	1.3	1.7	1.4	1.9	1.4	1.7	1.4	1.4	1.4	1.4	1.3	1.4	1.2	1.1
	1.2	1.2	1.2	1.4	1.1	1.2	1.6	0.7	1.4	1.4	1.4	1.4	1.9	1.5	1.6	1.5	1.4	1.4	1.5	1.3	1.5	1.2	1.1
	1.1	1.2	1.3	1.4	1.5	1.3	1.6	0.7	1.4	1.4	1.6	1.8	1.6	1.4	1.5	1.4	1.5	1.5	1.6	1.5	1.6	1.1	1.1
	1.0	1.5	1.2	1.4	1.5	1.3	1.6	0.7	1.4	1.4	1.6	1.6	1.6	1.4	1.6	1.6	1.5	1.6	1.3	1.4	1.6	0.9	1.0
	-	0.6	-	1.0	1.0	1.1	1.1	0.4	0.4	0.4	1.0	1.0	1.8	1.8	1.8	-	-	1.9	1.4	1.5	1.3	1.2	1.2

Figure 3. Yields for 50 x 50 ft. blocks, August 8, 1982 cutting, expressed as tons per acre.

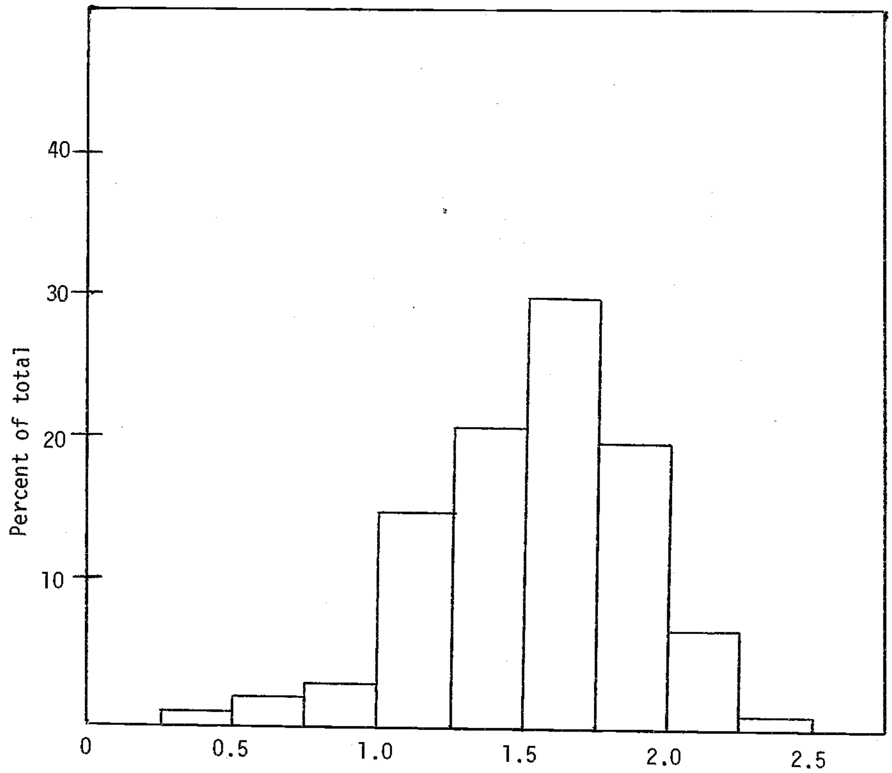

Figure 4. Frequency distribution of yield in 50 x 50 ft. blocks, August 8, 1982 cutting, tons per acre.

Excised Radicle Elongation of Alfalfa (Medicago sativa L.) in Various Salts at Differing Concentrations

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Summary

Excised radicle growth rates of the three populations of alfalfa in response to NaCl stress correspond to their original germination salt tolerances in NaCl solutions (AZ-ST 1982 > AZ-ST 1979 > Mesa Sirsa control). While this trend is not consistent for other salts studied (KCl, Na_2SO_4 and K_2SO_4), the control population always is less tolerant than either AZ-ST 1982 or AZ-ST 1979. This suggests that there may exist some biochemical connection or carry-over between germination **salt** tolerance and seedling salt tolerance.

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Three seeds lots of alfalfa seed cultivar Mesa Sirsa, representing three different levels of germination salt tolerance as developed by Dr. A.K. Dobrenz, were evaluated for excised radicle elongation in NaCl, KCl, Na_2SO_4 and K_2SO_4. The seed lots were as follows: foundation seed representing control populations unselected for germination salt tolerance; AZ-ST 1979 seed from parent plants that survived a moderate germination stress of -14 bar NaCl and AZ-ST 1982 seed from parent plants that survived a relatively high germination stress of -22 bars NaCl.

Preparation of Hoagland's solutions supplemented with either NaCl, KCl, Na_2SO_4, or K_2SO_4 at varying concentrations was conducted. Salt solution concentrations were theoretically determined on an ion equivalent basis, such that the Cl^- of KCl solutions were identical to the Cl^- of NaCl