PRODUCTION PRACTICES OF FARMERS OF THE RED RIVER VALLEY OF THE UNITED STATES

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INTRODUCTION

The 1971 acreage of cultivated sunflower (Helianthus annuus L.) exceeded 400 000 acres (160 000 hectares) in North Central United States. Ten years earlier, there were 13 000 acres (5 200 hectares) in the same region.

Since sunflowers were a relatively new crop to this area of the world, there was a need to study which production practices used by farmers increased productivity. Further, the confectionery trade was concerned with characteristics which contributed to a high percent of large hullable achenes, a measure of quality in the trade.

METHODS AND MATERIALS

A questionnaire was formulated and mailed in the spring of 1971 to more than 600 farmers who had contracted to grow the varieties D 693 and D 694 confectionery-type sunflowers for Dahlgren & Company, Inc. The questionnaire asked each grower to supply information concerning the production of sunflower on his farm (Table 1). Numerical values were assigned to the answers received to facilitate the entry of the data on computer cards. Fieldmen from the company estimated the average plant population of each field as they were visited during the growing season. Yield of achenes and percent of large seed were accumulated from scale tickets as the growers delivered the crop.

Data cards were processed through the computer at North Dakota State University to obtain the following :

1. Frequency distributions of each characteristic,

2. A contingency table to pair characteristics in all combinations, and

3. Simple correlation coefficients for all characteristics for which an hierarchical numerical value could be assigned.

Table 1 - Characteristics and numerical values assigned for classes for data gathered from the questionnaire.

Number Characteristic	Numerical Values
1. Seeding Data	Days from May 1st
2. Soil Type	Very Sandy = 1 . . . . heavy clay = 5
3. Soil Moisture	Very Dry = 1 . . . . . very wet = 5
4. Fertilizer Usage	None = 0, Fertilizer = 1
5. Amount of Nitrogen	Pounds per acre (45 lbs/A = 50 kg/ha)
6. Amount of Phosphorus	Pounds per acre (45 lbs/A = 50 kg/ha)
7. Amount of Potassium	Pounds per acre (45 lbs/A = 50 kg/ha
8. Method of Fertilizer Application	Broadcast = 1, In the Row = 2 & Beside the row = 3
9. Time of Fertilizer Application	Fall = 1, Spring = 2
10. Herbicide Usage	None = 0, Eptam (EPTC) = 1, Treflan (Trifluralin) = 2, Amiben (Chloramben) = 3, Other = 4
11. Rate of Herbicide Application	Pounds per acre (4.5 lbs/A = 5.0 kg/ha)
12. Time of Herbicide	Before = 1, During = 2, After = 3
13. Method of Herbicide Incorpor.	Disc = 1, Cultivator = 2, Harrow = 3, None = 4, etc...
14. Previous Crop 1970	Barley = 1, Wheat = 2, Oats = 3, Flax = 4, Potatoes = 5, Beans = 6, Summer Fallow = 7, Sugar Beets = 8, Sunflowers = 9, Other = 0.
15. Previous Crop 1969	Same as above
16. Fall Tillage	None = 0, Plow = 1, Disc = 2, Cultivator = 3, Harrow = 4, Plow & Disc = 5, Plow & Cultivator = 6, Plow & Harrow = 7, Disc & Cultivator = 8, Plow, Disc & Cultivator = 9
17. Spring Tillage Practice	Plow, Disc & Cultivator = 0, Plow = 1, Disc & Cultivator = 2, Cultivator = 3, Cultivator & Harrow = 4, Disc, Cultivator & Harrow = 5, Plow, Cultivator & Harrow = 6, Plow & Harrow = 7, Cultivator, Harrow & Other = 8, Plow & Cultivator = 9
18. Seedbed Condition	Excellent = 1, Good = 2, Fair = 3, Poor = 4
19. Seeding Implement	Plate-type corn planters = 1, Plateless-type corn planter = 2, Beet drill = 3, Grain drill = 4
20. Depth of Seeding	Number of Inches (1 inch = 2.5 centimeters)
21. Row Spacing	Number of Inches (1 inch = 2.5 centimeters)
22. Population	Plants per acre/1 000 (1 000 plants per acre = 2 500 plants per hectare)
23. Yield of Achenes	Pounds per acre/100 (1 000 pounds per acre = 1 136 kilograms per hectare)
24. Percent of Large Seed	Percent over a 20/64 inch (.78 centimeter) round hole screen

POPULATION (plants per hectare avg. = 32 250, plants per acre avg. = 12 900)

Plants Per Hectare	Under 24 700	24 700-29 651	29 652-34 593	34 594-39 535	Over 39 536	Total
Plants Per Acre	Under 10 000	10 000-12 000	12 000-14 000	14 000-16 000	Over 16 000	No.
	12	35	32	15	6	223

YIELD (kg/ha avg. = 1 162, Lbs/A avg. = 1 023)

Kg/ha	Under 795	796-907	908-1 021	1 022-1 135	1 136- 1 248	1 249-1 362	1 363-1 475
Lbs/A	Under 700	700-799	800-899	900-999	1 000- 1 099	1 100-1 199	1 200-1 299
	7	7	8	12	18	18	14

Kg/ha	1 476-1 589	Over 1 590	Total
Lbs/A	1 300-1 399	Over 1 400	No.
	8	7	253

PERCENT OF LARGE SEED, Over a .79 centimeter (20/64 inch) round hole screen (avg. = 71)

Under 50	51-60	61-70	71-80	81 & Over	Total No.
1	10	32	44	12	322

✗ Means (avg.) given in this table are unweighed.

Only the contingency tables involving yield of achenes and percent large seed in combination with the other characteristics were used in this report. These tables were employed to indicate the probability of one production practice predominating an alternative practice. Probabilities were obtained by totaling the number of observations in a class of the characteristic that exceeded the average yield or percent large seed and dividing by the total for that class. Arbitrarily classes with a frequency of 5 % or less were excluded to eliminate bias (Table 3 & 4). Likewise, the probability was computed on the total of all production alternatives for each characteristic.

Table 3 - Probabilities for each class of the characteristic production practices which gave over 1 000 lbs/A (1 136 kg/ha) yield of achenes (avg. = 1 023 lbs/A ; 1 162 kg/ha).

YIELD Vs SEEDING DATE (MAY)

11-15	16-20	21-25	26-30	31-35	Total
78	60	74	58	53	66

YIELD vs SOIL TYPE

Sandy	Inter	Clay	Hv Clay	Total
53	63	74	68	65

YIELD vs SOIL MOISTURE

V Dry	Dry	Inter	Wet	Total
84	69	60	70	65

YIELD vs FERTILIZER USAGE

None	Fert	Total
59	71	65

YIELD Vs FERTILIZER APPLICATION METHOD

Broadcast	Beside the Row	Total
76	50	71

YIELD vs TIME OF FERTILIZER APPLICATION

Fall	Spring	Total
100	68	70

YIELD vs HERBICIDE USAGE

None	Treflan	Amiben	Total Herb
59	77	73	81

YIELD vs PREVIOUS CROP

	Barley	Wheat	Oats	Summer Fallow	Total
1970	66	60	66	100	65
1969	50	65	67	85	66

YIELD vs FALL TILLAGE

Plow	Cult	Plow & Cult	Total
66	58	65	65

YIELD vs SPRING TILLAGE

Cult	Cult & Harrow	Disc, Cult & Harrow	Total
72	63	73	65

YIELD vs SEEDBED CONDITION

Excellent	Good	Fair	Total
69	62	72	65

YIELD vs SEEDING IMPLEMENT

Corn Planter (Plate-Type)	Corn Planter (Plateless-Type)	Beet Drill	Grain Drill	Total
66	76	66	37	65

YIELD vs DEPTH OF SEEDING

Centimeters	2.5	5.1	7.6	10.1	12.7	
Inches	1	2	3	4	5	Total
	66	63	63	80	100	65

YIELD vs ROW SPACING

Meters	.55	.76	.91	.96	
Inches	22	30	36	38	Total
	55	65	66	71	63

YIELD vs POPULATION

Plants per Hectare	Under 24 700	24 700-29 651	29 652-34 593	34 594-39 535	Over 39 536	Total
Plants per Acre	Under 10 000	10 000-12 000	12 000-14 000	14 000-16 000	Over 16 000	
	55	62	63	73	68	65

YIELD vs PERCENT LARGE SEED, over a .79 centimeter (20/64 inch) round hole screen

51-60	61-70	71-80	81-90	Over 90	Total
60	61	66	80	100	66

Table 4 - Probabilities for each class of the characteristic production practices which gave over 70 % large seed, over a 20/64 inch (.79 centimeter) round hole screen (avg. = 71 %).

LARGE SEED vs SEEDING DATE (MAY)

11-15	16-20	21-25	26-30	31-35	After 35	Total
64	59	65	62	60	40	62

LARGE SEED vs SOIL TYPE

Sandy	Intermediate	Clay	Heavy Clay	Total
36	57	63	84	61

LARGE SEED vs SOIL MOISTURE AT SEEDING

Very Dry	Dry	Intermediate	Wet	Total
72	65	58	63	61

LARGE SEED vs FERTILIZER USAGE

None	Fertilizer	Total
59	63	61

LARGE SEED vs METHOD OF FERTILIZER APPLICATION

Broadcast	Beside the Row	Total
60	69	62

LARGE SEED vs TIME OF FERTILIZER APPLICATION

Fall	Spring	Total
46	64	63

LARGE SEED vs HERBICIDE USAGE

None	Treflan	Amiben	Total Herb	Total
60	58	82	64	61

LARGE SEED vs PREVIOUS CROP

	Barley	Wheat	Oats	Summer Fallow	Total
1970	54	71	62	60	62
1969	73	71	65	57	63

LARGE SEED vs FALL TILLAGE METHOD

Plow	Cult	Plow & Cult	Total
62	60	55	61

LARGE SEED vs SPRING TILLAGE METHOD

Cult	Cult & Harrow	Disc, Cult & Harrow	Total
58	62	70	61

LARGE SEED vs SEEDBED CONDITION

Excellent	Good	Fair	Total
63	60	64	61

LARGE SEED vs SEEDING IMPLEMENT

Corn Planter (Plate-Type)	Corn Planter (Plateless-Type)	Best Drill	Grain Drill	Total
59	63	74	44	61

LARGE SEED vs DEPTH OF SEEDING

Centimeters	2.5	5.1	7.6	10.1	
Inches	1	2	3	4	Total
	50	69	56	60	61

LARGE SEED vs ROW SPACING

Meters	.55	.76	.91	.96	
Inches	22	30	36	38	Total
	100	60	50	55	58

LARGE SEED vs POPULATION

Plants per Hectare	Under 24 700	24 700-29 651	29 652-34 593	34 595-39 535	Over 39 536	Total
Plants per Acre	Under 10 000	10 000-12 000	12 000-14 000	14 000-16 000	Over 16 000	
	81	78	61	60	45	63

LARGE SEED vs YIELD

Kg/ha	Under 795	796-907	908-1021	1022-1135	1136-1248	1249-1362	1363-1475	1476-1589	Over 1590	Total
Lbs/A	Under 700	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	1300-1399	Over 1400	
	57	47	52	54	52	58	67	90	67	61

To interpret Table 3 and Table 4 one would, for example, study the first comparison between yield and seeding date. Note that the total probability was 66, but that seeding dates of May 11-15 and 21-25 gave probabilities of 78 and 74 respectively. These two seeding periods were more favorable to obtain above average yields than the other three periods. The highlights of Table 3 ware the use of fertilizers and herbicides, the practice of seeding on summer fallow, and seeding to obtain a population of 14 000 to 16 000 plants per acre (34 594 to 39 536 plants per hectare) all of which contributed more than alternative practices to above average yield of achenes.

Among those production practices which contributed to a high percentage of large seed were early seeding, heavy soils, use of fertilizers and herbicides, plus a relatively low population of plants (Table 4).

Listed in Table 5 are the simple correlation coefficients for all combinations of characteristics which could be assigned an hierarchical numerical value. Significant of highly significant simple correlations coefficients for 30 out of a possible 105 were obtained. Of particular interest are the highly significant correlations between yield of achenes and the use of fertilizer in the form of nitrogen, the lack of potassium fertilizer, and the use of an herbicide. Also, the correlations between high percent large seed and heavy soil type, narrow row spacing, low plant populations, and high yields were all highly significant.

Table 5 - Significant (*) and highly singificant (**) simple correlation coefficients for characteristics that could be assigned a hierarchical numerical value.

Characteristic	1	2	3	4	5	6	7	9	10.	18	20	21	22	23	24
1. Seeding Date			**											-*	
2. Soil Type			-**								*	-*			**
3. Soil Moisture									-*		-**				*
4. Fertilizer								**	**					**	
5. Amount of Nitrogen						**	*				**			**	
6. Amount of Phosphorus															
7. Amount of Potassium								-**				-**		-**	-*
9. Time of Fertilizer Application														-*	
10. Herbicide Usage												-**		**	
18. Seedbed Condition											*	**			
20. Depth of Seeding												*			
21. Row Spacing													-*		-**
22. Population															-**
23. Yield of Achenes															**
24. Percent of Large Seed															

CONCLUSIONS

One must consider the data presented here with a degree of reservation since it represented a one year study. However, the sample size, 334 maximum, for the various characteristics allowed for increased validity of the study. Plans were made at the outset that the study would continue for several years. The data from future years will allow comparisons to be made among years and observe changing trends, such as increased use of herbicides.

The conclusion was drawn that yield of achenes was influenced by the use of nitrogen fertilizer and of herbicides. The percent of large seed was influenced most by heavy soils, narrow row spacings, low populations and was highly correlated with high yields.