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PROJECT TITLE: Dryland Evaluation of Standard and Specialty Oil Safflower Varieties.

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OBJECTIVES:

Safflower serves as an excellent crop component in many areas of northern Montana in flexible dryland rotations with small cereal grains. A significant portion of the north central cropping area has climatic conditions suitable for production of standard oil safflower; and certain smaller, yet significant areas further possess specific climatic conditions required for production of specialty safflower lines of the high-oleic oil type. It is the objective of this study to evaluate existing commercial entries along with promising experimental lines being developed at Sidney to determine varietal appropriateness, and subsequent release and recommendation information specific to environmental conditions in northern areas. The MAPS program is utilized to refine the definition of areas appropriate for the production of quality safflower.

RESULTS:

Entries in the 1994 safflower variety trial performed moderately well, particularly in view of the less than desirable stand percentages achieved for most varieties and lines. Moisture within the seed placement zone was very limited at planting time. Light rains shortly after planting served to magnify minor surface soil moisture status differentials common at Havre when seedbeds are borderline dry. Then, 0.6 inches was received in a single event five days after planting. This resulted in some crusting, which when coupled with the fact seed quality for many lines was less than desirable (progeny of 1993 plantings in Montana wherein the season was too wet, short and cool for quality seed development), had a weakening effect on overall emergence and vigor.

For the stands that were achieved, the 1994 season at Havre was outstanding from a safflower production standpoint. Planting was accomplished early enough, the last spring freeze was 11 days earlier than normal, sub-soil moisture was very good, early season precipitation was generally above normal, July mean temperature was nearly 70 degrees F, and GDD values (base 50) were 108 percent of normal with July-September GGD being 111 percent greater than the 1951-1994 average for Havre. Mean yields, although mediocre at 908 lbs/ac, were coupled with test weights averaging 41.6 lbs/bu and 8%-moisture oils achieving a mean of 40.5 percent over the 18 entries evaluated.

The 1993 safflower trials at Havre did not mature due to the short, wet and cool growing season. Although a rare occurance in established Montana safflower production areas, such was pretty much the case throughout most of the state in 1993. The 1992 safflower trials and foundation increase fields on-station at Havre were a total loss as a result of severe hail received on three occasions between early July and early August.

Stand percent, flower date, plant height, yield, test weight, and oil data for the 1994 trial are presented in Table 1. Long-term (1985-1994) yield and percent

oil summaries on selected entries are presented in Table 2.

`Finch', Montana developed, currently yields very well among released, standard cultivars on a `Ten-year Comparable Average' basis at Havre. Finch, a white-hulled line, features higher test weight; and serves as a more disease-resistant replacement for `S-208' in the birdseed market. However, the average oil content of S-208 is nearly 4 percent higher than that of Finch.

`S-317' (oleic), S-208 and `S-541' continue to perform very well under dryland conditions in the Havre area as alternaria and/or pseudomonas disease organisms have generally not become factors limiting production. `Saffire' has yielded well, but its' oil content is 7 and 9 percent lower than S-208 and S-541, respectively. Other named varieties among those yielding slightly less, but within 10 percent of the check are `Girard', `Montola 2000' (high oleic) and `Centennial.' Girard's primary advantage is resistance to alternaria and bacterial leaf blights. Centennial's oil production is 106 and 102 percent of S-208 and S-541, respectively.

SUMMARY:

Single trials were established annually on-station at Havre using standard plot techniques in a randomized complete block design. Entries were planted in 4 or 6-row plots, 20 feet in length on a 12-inch spacing utilizing a `Rem' self-propelled cone seeder equipped with `Acra-plant' hoe openers. Plots were trimmed to 16 feet and harvested with a `Hege 125C' plot combine. Other variables specific to the trials are listed in the data table. Data is summarized for selected entries having been tested 3 years or more during the reporting period 1985-1994. No data were available for 1992 due to severe hail injury, nor the 1993 crop due to a short, cool, and wet growing season.

FUTURE PLANS:

It is planned that these investigations be continued on an annual basis in on-going support of the Montana safflower breeding and variety development project.

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1

TABLE 1. DRYLAND FALLOW SAFFLOWER VARIETY PERFORMANCE NURSERY. NORTHERN AGRICULTURAL RESEARCH CENTER. HAVRE, MONTANA. 1994.

ID	VARIETY or SELECTION	STAND % (July 8)	FLOWER DATE 1/	PLNT HT Inches	YIELD Lbs/Ac	TEST WT Lbs/Bu	OIL % @0%Moist.	---- OIL ---- % @8%Moist.	Lbs/Ac
12	STIRLING	68.33	206.33	20.43	1185.13	42.47	38.38	35.31	418.70
13	SAFFIRE	58.33	206.33	19.30	1173.20	42.37	37.70	34.68	411.40
02	MONTOLA 2000	98.33	205.00	18.71	952.10	40.87	46.77	43.03	409.80
06	S-317	86.67	207.33	21.25	975.27	40.87	45.58	41.93	408.60
04	FINCH	81.67	207.67	22.11	1072.07	44.53	40.43	37.20	398.03
07	S-208	75.00	208.00	23.12	966.77	41.50	44.15	40.62	390.10
03	S-541	93.33	206.33	21.65	907.33	42.13	46.63	42.90	388.93
18	91B 1282	90.00	207.00	20.31	909.90	43.03	45.09	41.48	377.07
17	91B 6668	65.00	208.67	19.33	888.63	41.00	45.67	42.02	373.27
15	90B 6011	98.33	205.67	24.27	873.83	40.57	45.48	41.84	365.57
16	90B 2763W	80.00	206.67	21.23	873.23	39.07	44.08	40.55	354.33
11	MONTOLA 2001	98.33	207.00	20.80	822.87	41.63	46.01	42.33	348.30
08	MORLIN	75.00	207.00	21.17	858.20	42.00	43.17	39.71	340.73
05	GIRARD	86.67	206.67	23.24	830.00	41.67	44.06	40.53	336.33
14	88B 3006	91.67	208.00	20.88	813.83	41.20	44.56	41.00	334.07
01	CENTENNIAL	100.00	206.00	21.63	780.57	41.70	45.79	42.12	328.80
09	MT 3697	63.33	209.00	21.61	761.83	42.50	46.79	43.05	326.83
10	OKER	73.33	206.33	20.18	692.57	40.20	42.35	38.96	269.27
EXPERIMENTAL MEANS		82.41	206.94	21.18	907.63	41.63	44.04	40.51	365.56
C.V. 2: (S OF MEAN/MEAN)*100		6.66	.21	2.90	9.58	.35	1.19	1.19	9.99
LSD (0.05)		15.79	1.23	1.76	249.85	.42	1.51	1.38	104.98

1/ No. of Days from January 1 (207 = July 26)

CLIMATIC and NURSERY MANAGEMENT DATA

Seeding Date: 04/19/94
Harvest Date: 09/19/94
Seeding Depth: 1.50 in.
Soil Series: Kevin Clay Loam
Previous Crop: Fallow after SW
Soil Temp @ Sdg: 62F @ 2in., 58F @ 4in.
Root Penetration Depth: N/A
Depth to Moisture at Sdg: 1.75 in.
Probed Moist.Depth @ Sdg: 55.0 in.+
Herbicide: Trifluralin @ .75#/ac

Measured Soil Water on 04/11/94: 7.89 in. (sampling depth = 48 in.)
Precipitation 04/11/94 to Seeding: .02 in (00.0 in events > .1 in.)
Initial Stored Soil Water at Seeding: 7.91 in. (sampling depth = 48 in.)
Measured Soil Water at Harvest: 1.42 in. 2/ (sampling depth = 24 in.)
Growing Season Precipitation (Sdg.to 14 days prior to harvest maturity `HM'):
Total - all measurable events: 6.32 in.
Total - all events >.1 inches: 5.51 in.
Post Growing Season Precipitation (within 14 days of harvest maturity):
Total - all measurable events: .00 in.
Total - all events >.1 inches: .00 in.
Adj'd Residual Soil Water @ (HM-14d): 1.42 in. 2/ (sampling depth = 24 in.)
Soil Analysis on 04/11/94 (NO3,P,K at 0-6 in.; NO3 at 6-24, 24-36 & 36-48 in.):
NO3(lbs/ac)= 250 , P(ppm olsen)= 19 , K(ppm)= 273 , pH= 8.2, O.M.(%) = 1.2
Fertilizer: 70#N,40#P2O5/ac via 46-0-0+11-52-0 bd'cst & till-incorporated 9/93
2/ Hydraulic probe was unable to penetrate greater than 24" following harvest.

TABLE 2. TEN-YEAR YIELD AND PERCENT OIL SUMMARY ON SELECTED ENTRIES FROM A FALLOW SAFFLOWER VARIETY PERFORMANCE NURSERY. NORTHERN AGRICULTURAL RESEARCH CENTER. HAVRE, MONTANA. 1985-1994.

		YIELD (POUNDS PER ACRE)								OIL (Percent by Weight) @ 8% MOISTURE							
VARIETY OR SELECTION	NO. OF YEARS TESTED 1/	1990	1991 2/	1992 3/	1993 3/	1994	AVERAGE FOR YEARS TESTED	10-YR. COMPAR. AVERAGE YIELD 4/	PERCENT OF S-208 YIELD 5/	1990	1991 2/	1992 3/	1993 3/	1994	AVERAGE FOR YEARS TESTED	10-YR. COMPAR. AVERAGE OIL % 4/	PERCENT OF S-208 OIL % 5/
FINCH	8	931.9	2049.0	-	-	1072.1	1209.7	1209.7	125.6	35.5	37.7	-	-	37.2	38.9	39.0	90.9
S-317	6	887.4	1264.8	-	-	975.3	1216.3	1074.5	111.6	39.0	41.4	-	-	41.9	42.9	45.0	104.9
S-541	8	838.5	1269.1	-	-	907.3	1040.7	1040.7	108.1	41.8	41.7	-	-	42.9	44.4	44.5	103.7
82B3555	4	948.3	-	-	-	-	1176.2	991.5	103.0	41.1	-	-	-	-	43.5	44.3	103.3
S-208	8	808.6	1483.0	-	-	966.8	962.8	962.8	100.0	37.8	39.1	-	-	40.6	42.8	42.9	100.0
SAFFIRE	6	688.8	1732.5	-	-	1173.2	1166.5	960.2	99.7	31.0	33.0	-	-	34.7	34.3	35.5	82.9
87B1298	3	926.1	1172.3	-	-	-	961.7	912.2	94.7	39.5	38.7	-	-	-	39.6	42.5	99.2
85B1837	3	904.8	-	-	-	-	850.6	910.6	94.6	35.8	-	-	-	-	40.5	41.7	97.4
GIRARD	8	910.1	1156.0	-	-	830.0	892.0	892.0	92.6	38.6	39.7	-	-	40.5	40.9	41.0	95.7
MONT 2000	3	884.0	1139.3	-	-	952.1	991.8	879.2	91.3	42.0	41.6	-	-	43.0	42.2	46.2	107.7
CENTENNIAL	5	948.7	1239.8	-	-	780.6	934.9	874.3	90.8	41.6	41.9	-	-	42.1	43.5	45.4	105.9
82B1277	3	957.1	-	-	-	-	1018.4	863.2	89.6	37.7	-	-	-	-	43.2	44.2	103.1
87B1650	3	817.8	1191.2	-	-	-	907.3	860.5	89.4	38.7	38.8	-	-	-	39.7	42.7	99.5
HARTMAN	3	-	-	-	-	-	1097.4	858.9	89.2	-	-	-	-	-	38.1	38.3	89.4
85B4431	4	774.2	1176.4	-	-	-	876.9	807.7	83.9	34.5	37.3	-	-	-	39.0	40.8	95.2
83B1954	5	814.4	-	-	-	-	985.1	799.2	83.0	39.8	-	-	-	-	43.5	44.0	102.7
6/ OKER	8	759.6	1549.9	-	-	692.6	696.1	696.1	72.3	37.5	39.5	-	-	39.0	41.3	41.4	96.5
MT 3697	4	-	725.7	-	-	761.8	771.6	684.9	71.1	-	41.8	-	-	43.1	43.6	44.9	104.7
85B3918	3	741.6	-	-	-	-	492.7	527.5	54.8	43.0	-	-	-	-	45.6	47.0	109.6
MEAN (ENTRIES LISTED)		855.4	1319.2	-	-	911.2	-	884.5	-	38.5	39.4	-		40.5	-	42.7	-
7/ Grwg Ssn Ppt. (in.)		4.92	10.27	10.19	-	6.32	7.69										
8/ Sl PAW in. to SD@Plt		7.50	10.02	7.59	-	7.91	8.87										
Tot Plt Avl Water (in.)		12.42	20.29	17.78	-	14.23	16.56										
Soil NO3(lbs) to SD@Plt		232.0	204.0	252.0	-	250.0											
SD (Smpling Dpth inches)		48.0	48.0	48.0	-	48.0											
Fertilizer App. (# N)		45.0	70.0	70.0	-	70.0											
(# P2O5)		30.0	40.0	40.0	-	40.0											

Check variety is S-208.

1/ Only the five most recent years are shown, but the summary calculations include all the years noted.

2/ Stands were variable due to soil crusting following a 1.8" cloudburst 10 days after planting. Affected most were Finch, 85B 3829, Oker, and Saffire.

3/ The 1992 nursery was destroyed by hail in July and frost in August.
The 1993 nursery was destroyed by frost and snow in August.

4/ 10-yr. CA = (x/y) * where x = average yield or oil content of the entry for years tested, y = average yield or oil content of S-208 for the same years, and z = 10-yr. average yield and oil content for the check variety S-208.

5/ Percent of S-208 yield or oil content for the same data years.

6/ 80B 2793 in 1982, 80B 2793-2 in 1983.

7/ Seeding to 14 days prior to harvest maturity.

8/ Depth of moist soil (ft.) * 2.00 in. PAW/ft except starting in 1986 where soil PAW values are actual gravimetric measurements.