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SOLID-SEEDING SUNFLOWERS ON DRYLAND IN WESTERN CANADA

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Abstract

From 1975-1977, research was conducted on dryland farms in Western Canada to identify areas and soil types suitable for sunflower production under extensive crop management conditions. Sunflowers were "solid-seeded" on summerfallow using standard grain drills or discers. Wheat was grown as the control adjacent to the sunflowers. Average sunflower-standing yields ranged from 42 to 79% of the adjacent wheat on a weight basis. Relative and absolute sunflower yields and seed oil contents were the greatest on Dark Brown and Black soils of southeast Saskatchewan and Alberta, and the poorest on Brown soils in southwest Saskatchewan.

Rapeseed (*Brassica napus* L.), turnip rapeseed (*Brassica campestris* L.) and sunflowers (*Helianthus annus* L.) have been grown in Western Canada on a commercial scale since 1943. The production of rapeseed has concentrated in the parkbelt and transition zones of the Black and Grey-wooded soils, and in 1978 exceeded 2 million hectares. Sunflowers have centered in the Red River Valley of south central Manitoba where the longer growing season and row crop production techniques have favored the crop.

Hazards from soil drifting and extended hot, dry periods during flowering have tended to limit the extension of rapeseed onto the drylands of southern Saskatchewan and Alberta. Although sunflowers have been grown on the drylands on several occasions since 1958, production has never been sustained on a continuing basis. Inadequate weed control options in the early years and the lack of row-crop equipment in an area where crop production is extensive rather than intensive has restricted the expansion of sunflowers outside the traditional row-crop area of Manitoba.

In recent years with the availability of selective herbicides, solid-seeding of sunflowers with standard grain drills has become more widely used in Manitoba. Solid-seeded sunflowers in 1971 and 1972 on farms in Manitoba were reported to exceed row-crop sunflowers in yield by a wide margin (Tsukamoto and Dorrell, 1976). Based on this experience with solid-seeding, field-scale experiments were undertaken on the drylands of Saskatchewan and Alberta to identify areas and soil types which might be suitable for the production of sunflowers under extensive management conditions. Wheat served as the control in these experiments, thereby permitting estimates of sunflower productivity to be determined both on an absolute and relative basis.

Materials and Methods

In each year from 1975-77, producers were contracted to grow sunflowers and wheat on adjacent summerfallow. Test sites were situated in southern Saskatchewan and Alberta at locations and on soils identified in Table 1. Two to four experiments were conducted during the three years at each location. Fields ranged from 8 to 80 hectares in size.

The sunflowers and wheat were seeded with standard grain drills and discers available on each farm. For sunflowers, the implements were calibrated to deliver approximately 85,000 seeds/hectare in row spacings of 30-45 cm. To achieve these row spacings, alternate seed runs or every second and third run were blocked with tape. Some implements required speed reduction kits between the drive wheel and the feed shaft in order to obtain low enough seeding rates.

TABLE 1. Locations and Soil Characteristics of Farm Test Sites

Province and Location	Soil Zone	Texture
S.E. Saskatchewan		
Carnduff	Dk. Brown or Black	SiL-FSL
Trossachs	Dk. Brown	CL
Yellow Grass	Dk. Brown	HvC
Regina	Dk. Brown	HvC
S.W. Saskatchewan		
Lemsford	Brown	SiL
Cabri	Brown	SiCL
Alberta		
Claresholm	Dk. Brown	VL
Pulteney	Dk. Brown	VL
Vulcan	Dk. Brown	VL
Drumheller	Dk. Brown or Black	HvC

For weed control, trifluralin (Treflan) was applied at or before seeding at 1.2 kg/ha and incorporated immediately after application. If disc seeding implements had been fitted with sprayer attachments, the seeding and herbicide application were combined. The sunflowers were cross-harrowed in the 2-6 leaf stage as required to control broadleaf weeds. Wheat was treated with 2,4-D and other selective herbicides as required to control broadleaf weeds and grasses. Ammonium phosphate fertilizer was applied with the seed to both crops at rates up to 50 kg/ha.

In 1975 and 1976, "Krasnodarets" sunflowers were grown while in 1977 "Saturn" sunflowers were grown. In all years, hard red spring wheat was grown as the control except at Cabri and Lemsford where durum wheat was grown. Yields were determined in all but two fields during the three years from up

to 10 samples per field after maturity but before harvesting. The sample area in sunflowers was 9.3 m^2. The area in wheat varied from 1 m^2 to 20 m^2, depending on whether the crop was standing or lying in swath. The hand samples were threshed using a Hege plot combine, dried and cleaned prior to weighing to determine standing yields. Harvested yields were estimated by the producer and were a single estimate in each year. Variances in the estimate of the year within location means were calculated from variance components using a completely nested design of farms within years within location.

Results and Discussion

An evaluation of sunflowers as an alternate crop to wheat production on the drylands of Western Canada requires information on the ease of substitution of the crop in the rotation, relative yields, residual effects of sunflowers on subsequent crops and the cost structures for production and marketing. Previous efforts to expand the production of sunflowers to the drylands have been hampered by the lack of such information. One of the disincentives to the growing of sunflowers in an extensive management area has been the requirement for specialized equipment. Solid seeding of sunflowers with standard grain drills is an attractive alternative to row-crop seeding as investments in new equipment can be minimized at the outset.

The high yields from solid-seeded sunflowers in Manitoba in 1971 and 1972 (Tsukamoto and Dorrell, 1976) can perhaps be attributed to the high seeding rates and narrow row spacings used in solid seeding. Sunflowers generally yield well over a wide range of plant populations from 30,000 to 85,000 plants per hectare (Robinson et al, 1976). In favorable environments as the yield potential approaches the yield capacity of the cultivar grown, populations of 70,000 - 85,000 have been favored. However, at populations above 85,000, interplant competition usually becomes excessive and yields declined. Under extreme drought conditions at Swift Current, Saskatchewan, and at Mandan, North Dakota, low populations of 25,000 - 50,000 and narrow rows of 60-30 cm provided greatest yields (Vijayalakshmi et al, 1975; Alessi et al, 1976). In the current experiments, the grain drills were calibrated to deliver approximately 85,000 seeds per hectare. Plant populations at flowering ranged from 60,000 to 70,000 plants per hectare and were lower than seeding rates due to variable emergence, insect damage and losses from cross-harrowing.

Differences in stand establishment and seed distribution were observed amongst various drills and discers. Press drills and hoe drills generally provided more uniform emergence than discers due to superior depth control and packing. Any effect of implement on stand establishment was assumed to be similar for sunflowers and wheat. The distribution of sunflower seed from the metering mechanisms of the drills was variable, particularly with fluted cylinder metering devices. Metering uniformity was improved if drive-speed reduction gears and wide seed cup openings were used. The internal double run seed cup mechanism delivered seed more uniformly than fluted cylinder devices but did not approach a planter mechanism for uniformity.

The 3-year location averages for sunflower standing yields ranged from 1,010 to 1,810 kg/ha at the various locations (Table 2). Harvested yields

realized by the producers ranged from 880 to 1,570 kg/ha and, on the average, were 210 kg/ha lower than standing yields. As harvesting occurred two to three weeks after yield sampling, the standing sunflower crop was subjected to several environmental stresses, which resulted in significant yield losses in some cases. Shattering, stem breakage and bird depredation were the most frequent sources of yield loss. In addition, the lower harvested yields may reflect the relative inexperience of the producers in adjusting combines for harvesting sunflowers.

TABLE 2. Comparison of Sunflower and Wheat Production on Dryland in Western Canada, 1975-77.

Province and Location	No. Tests, Years	Standing Yield kg/ha	Standing Yield % wheat	Harvested Yield kg/ha	Harvested Yield % wheat	Oil Content % dry basis
S.E. Saskatchewan						
Carnduff	4, 3	1460	68	1370	71	46.1
Trossachs	4, 3	1540	74	1140	57	45.8
Yellow Grass	4, 3	1130	76	960	69	44.9
Regina	2, 2	1470	62	1110	53	40.7
S.W. Saskatchewan						
Lemsford	3, 3	1010	51	880	44	40.8
Cabri	3, 3	1130	42	970	49	39.8
Alberta						
Claresholm	3, 3	1810	69	1570	52	45.4
Pulteney	2, 2	1250	79	1080	59	47.1
Vulcan	3, 3	1110	67	1140	57	44.7
Drumheller	2, 2	1580	69	1180	44	37.3
Variance of estimate year within location mean		10.2[a]	437	9.8[a]	470	10.9

[a] times 10^4

Sunflower standing yields as a percentage of standing wheat ranged from 62 to 79% on Dark Brown and Black soils in southeastern Saskatchewan and in Alberta. Harvested sunflower yields in these areas as a percentage of harvested wheat were lower than comparable standing yields and ranged from 44 to 71%. These lower percentages suggest that the sunflowers suffered relatively greater losses than wheat after maturity due to predation, shattering or combining.

Sunflower yields in the drought-prone areas of Lemsford and Cabri north of Swift Current, Saskatchewan, on Brown soils fell below 50% of wheat. The decline in sunflower yields relative to wheat was accompanied by a decline in seed oil contents to less than 40% (dry basis). Yields and oil contents from this area were similar to those reported for plant population and row spacing experiments conducted at Swift Current in 1973 (Vijayalakshmi et al, 1975). Drought during the critical stages of head formation and seed development severely limited sunflower production in these latter experiments.

Several factors other than drought affected sunflower production and are worth noting as their influence on the observed yields was significant. At Cabri and Lemsford in 1975, an early fall frost seriously affected seed set and oil content. In addition, high winds caused extensive shattering and stem breakage. At Trossachs and Yellow Grass in June 1976, excessive precipitation for the period resulted in extensive flooding with the sunflowers being more seriously affected than wheat. In addition, deformities and low seed set typical of damage from 2,4-D drift (Greenshields and Putt, 1958) resulted in significant yield reduction at Trossachs. At Yellow Grass in 1977, on a burnout solonetzic soil, a lower level of management than occurred in previous years during seedbed preparation and seeding resulted in poor stand establishment and heavy weed infestations.

Conclusions

Within the drylands of Western Canada, sunflowers appear to be a promising alternate crop only on the Dark Brown and Black soils of southeast Saskatchewan and southern Alberta. In these areas sunflower-standing yields relative to wheat averaged 71%. Assuming farm-gate prices for sunflowers were 150% or higher than wheat on a weight basis, sufficient economic returns would appear to be obtainable to compensate for the extra management and higher production risks associated with the sunflower crop. On Brown soils in southwest Saskatchewan, sunflower yields were distinctly lower than from other areas and fell to less than 50% of wheat.

Solid-seeding of sunflowers with the standard grain drill or discer was demonstrated to be a feasible substitute for row-crop planters. Specialized equipment required to grow the sunflowers was limited to the sunflower header attachment for the combine. Only minor adjustments were necessary to calibrate the drills to deliver sunflower seed at the desired plant population and row spacings. However, seed delivery patterns were less uniform than delivery patterns from precision planters. Use of selective herbicides to control broadleaf weeds and grasses would appear to be mandatory in solid-seeding sunflowers as interrow tillage would generally not be feasible.

The sunflower yield relationships obtained in these experiments probably represent minimums from which further increases in sunflower yields might be expected. The development of grain drills to side-band phosphate fertilizer and the release of higher yielding, early open-pollinated and hybrid cultivars have the potential of increasing yields substantially. The threat of blackbird predation, however, could be a significant deterrent to the expansion of the acreage into many areas.

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