REDEFINING IRRIGATED FIELD PEA AGRONOMY

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INTRODUCTION

Pea (*Pisum sativum* L.) is a widely grown crop with diverse uses. Seed protein of content 20%-24% makes pea a valuable protein source for humans and livestock. Pea is consumed in whole or split form and as flour. Pea fiber, purified starch, and protein isolate are some of the industrial uses of pea. Pea production offers a number of advantages:

1. Nitrogen fertilizer costs can be reduced because pea is capable of fixing upto 80% of its nitrogen requirement under optimum nodulation. In addition, pea vines can return about 25 kg N per hectare.
2. Pea can extend cereal rotations.
3. Early seeding and early harvesting of pea can spread the work load during the cropping season.
4. No specialized farm equipment is needed.
5. There is no quota requirement for pea.
6. Growing pea reduces presently uneconomical cereal acreage.
7. Livestock farmers can produce an economical on-farm protein source.

Pea has large domestic and export markets. Canadian pea exports ranged from 240,000 to 342,000 tonnes between 1985 and 1990. Saskatchewan is a major pea producer in Canada. Pea production statistics for Saskatchewan for the past five years are summarized in Table 1.

Table 1. Field pea production statistics of Saskatchewan: 1985 - 1991.

Year	Area ('000 ha)	Production ('000 tonnes)	Yield (kg/ha)
1987	28.3	57.2	2021
1988	172.0	157.9	918
1989	80.9	95.0	1174
1990	52.6	103.0	1958
1991	77.7	158.4	2039

Source: 1991 Specialty Crop Report, Saskatchewan Agriculture and Food

In Saskatchewan most of the pea production is on dryland. Pea yields are dependent mainly on the moisture during the growing season. The low average yield during 1988 (Table 1) was due to drought. Supplemental irrigation can alleviate moisture stress and ensure successful crop production.

Research on irrigated pea production was initiated at the Saskatchewan Irrigation Development Centre, Outlook in 1987, as part of the Specialty Crops Development Program. This was funded by the Canada-Saskatchewan Irrigation Based Economic Development Agreement. The objectives of the project were to identify suitable cultivars and develop agronomic practices for field pea production under irrigated conditions in South Central Saskatchewan. Results of research trials and demonstration projects conducted 1987 through 1991 under irrigation are summarized in this paper. All yields reported are marketable yields adjusted to 16% moisture.

Cultivar Evaluation

Several registered cultivars and advanced breeding lines were tested under irrigation through various cooperative yield trials. Several of the high yielding cultivars under dryland conditions performed well under irrigation (Table 2). Cultivars with short stature and semi-leafless plant types performed well under irrigation. These cultivars were less likely to lodge, thereby helping to control yield loss due to diseases, particularly *Sclerotinia*.

Table 2. Plant characteristics and productivity of some registered pea cultivars.

Cultivar	Plant height	Leaf type	Yield[z] (kg/ha)
Bellevue (Y)	Tall	Standard	4149
Century (Y)	Tall	Standard	3771
Express (Y)	Short	Tare	4306
Radley (G)	Short	Semi-leafless	3843
Tara (Y)	Tall	Standard	4569
Titan (Y)	Tall	Standard	3897

z- Average of four years (1988-1991)
G- Green cotyledon.
Y- Yellow cotyledon.

Seeding Date

Pea seedlings can tolerate frost to about -5°C. Due to the hypogeal germination habit frost damaged pea seedlings are capable of regrowth from underground axillary buds. Pea can be seeded early in the spring, when the first 3 cm of the soil reaches 5°C. Early seeding is beneficial in order to maximize benefit from spring and early summer rainfall when cooler temperatures prevail. This allows early harvesting which is particularly important with green pea to avoid bleaching of seeds.

Seeding date studies were conducted in 1989 and 1990 in large scale demonstration plots under commercial conditions using Radley pea. Early seeding produced significantly higher yields and larger seeds compared to late seeding (Table 3).

Table 3. Yield and average seed weight of Radley pea sown between April 15 and May 28

Seeding date	Harvest date	Mean yield (kg/ha)	Average seed weight (mg)
Apr. 15-25	Aug. 3 (105)	3016 a	199 a
Apr. 26-May 6	Aug. 14 (106)	3025 a	187 b
May 7-17	Aug. 18 (97)	2808 a	180 b
May 18-28	Aug. 24 (94)	1926 b	139 c
C.V. (%)		14	5

- Means within columns followed by the same letter are not different at P <0.05 level of significance.
- Values within parenthesis are average days to maturity.

Seeding Rate

The recommended seeding rate for pea, based on several dryland studies, is 80 seeeds/m^2. Seeding rates of 55, 80, and 110 seeds/m^2 were tested in 1989 and 1990 using Radley pea. No significant differences were observed among seeding rates (Table 4). For irrigated pea production, the seeding rate can be reduced by about 30 % from the present recommendation without affecting yield provided that weed competition is not a problem. At the higher seed rates, the stand densities were much lower than the targeted level, likely due to greater inter-plant competition at the higher seeding rates than in the lower seeding rates (Table 4).

Table 4. Stand density and yield of Radley pea in response to different seeding rates.

Target stand[z]	Actual stand[z] 1989	1990	Yield (kg/ha) 1989	1990
55 (132)	61	56	3485 a	5054 a
80 (208)	75	66	3564 a	5046 a
110 (110)	83	77	3592 a	5177 a
C.V. (%)	18.9	-	8.5	11.0

z - Plant stand (number of plants/$m^{2)}$
- Means within columns followed by the same letter are not different at P <0.05 level of significance.
- Values within parenthesis are seed rates in kg/ha.

Seeding Depth

A two year study with Radley pea seeded at 2.5, 5.0, and 7.5 cm depths showed that seeding depth did not affect plant stand or seed yield (Table 5). Adequate soil moisture at seeding time, provided by irrigation, allowed normal germination and emergence from 2.5 to 7.5 cm depth.

Table 5. Stand density and yield of Radley pea seeded at three different depths, 1989 and 1990.

Seeding depth (cm)	Stand (plants/$m^{2)}$ 1989	1990	Yield (kg/ha) 1989	1990
2.5	75 a	66	3580 a	4834 a
5.0	70 a	68	3583 a	5180 a
7.5	74 a	65	3478 a	5234 a
C.V. (%)	18.9	-	8.5	11.0

- Means within columns followed by the same letter are not different at P <0.05 level of significance.

Germination and Stand Density

Germination failure and poor plant stand is a frequently reported problem, particularly with large seeded pea cultivars. An experiment conducted in 1991 using Progreta, Express, and Radley pea (average seed weights of 319, 260, and 210 mg respectively), showed no differences in plant stand (Table 6). There were significant differences in yield among cultivars.

Table 6. Plant stand and yield of pea cultivars with different seed sizes, 1991

Cultivar	Stand (plants/m^2)	Yield (kg/ha)
Progreta (319)	73 a	5531 b
Express (260)	77 a	5032 a
Radley (210)	73 a	5586 b
C.V. (%)	18.6	12.3

- Means within columns followed by the same letter are not different at P <0.05 level of significance.
- Value within parentheses are average seed weight.

Fungicidal seed treatments were used to control germination loss caused by soil borne pathogens in a 1991 experiment. No diseases were observed during germination, which resulted in optimum seed germination including that of the check treatment. Fungicidal seed treatment offered no added advantage with respect to plant stand or seed yield during the 1991 season (Table 7).

Table 7. Plant stand and seed yield of pea in response to fungicidal seed treatment.

Treatment	Stand (plants/$m^{2)}$	Yield (kg/ha)
Apron	83 a	6611 a
Crown	80 a	6635 a
Captan	82 a	6630 a
ICIA0523	79 a	6584 a
Check	78 a	6717 a
C.V. (%)	12.3	12.1

- Means within columns followed by the same letter are not different at P <0.05 level of significance.

Irrigation Scheduling

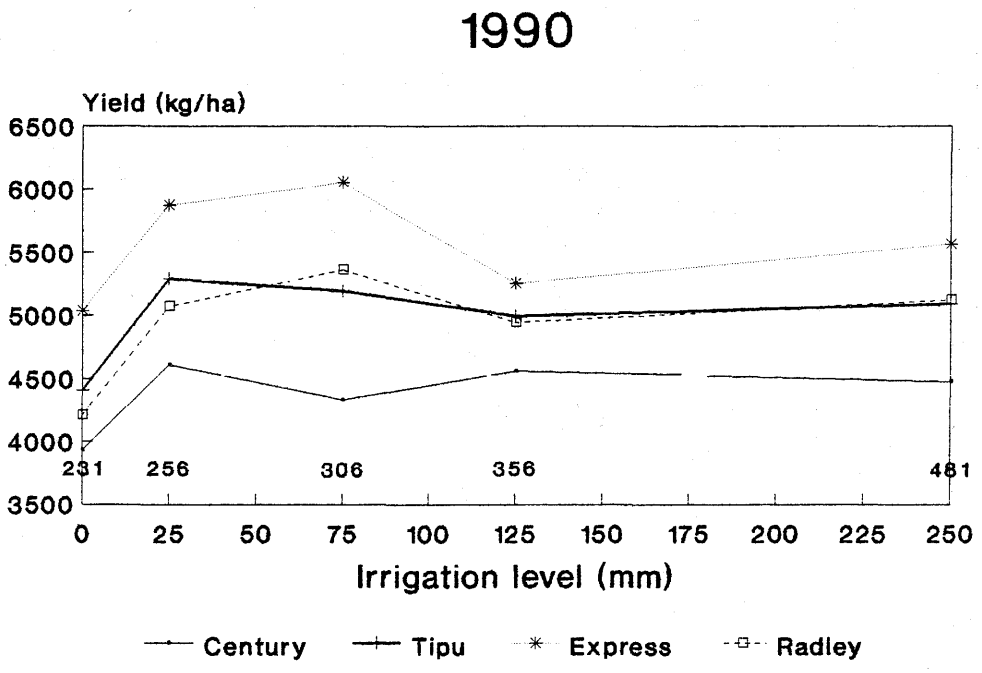
Pea requires a moist but well drained seed bed for successful germination. Pea is sensitive to moisture stress at flowering. Adequate soil moisture is essential immediately prior to and during flowering particularly for short stature cultivars with determinate growth habit. An experiment was conducted to compare the effect of irrigation on pea cultivars with contrasting growth habits, i.e. Radley (semi-leafless, short), Tipu (semi-leafless, tall) Express tare-leaf, short), and Century (standard-leaf, tall) pea. The test was conducted under the linear irrigation system capable of controlled water delivery. Pea responded positively to about 300 to 350 mm of total water (irrigation + rainfall) which corresponded to approximately 25 to 75 mm and 25 to 50 mm of irrigation during 1990 and 1991, respectively (Figure 1). Analysis of variance showed highly significant cultivar x irrigation interaction during 1990 but not in 1991. The interaction significance during 1990 was due to greater degree of *Sclerotinia* infection in tall cultivars compared to the short types. This resulted in a yield depression in the tall peas. The 1991 season was free of disease, thus, both tall and short types responded similarly to different irrigation levels.

Fungicide Application to Control Foliar Diseases

Environmental conditions were favourable for disease incidence (*Sclerotinia*) during 1990. Foliar fungicide application was beneficial in controlling disease and increasing seed yield (Table 8). There was no effect of fungicide on pea yield in the 1991 test.

Table 8. Yield response of field pea to foliar fungicide application, 1990.

Treatment	Yield (kg/ha)
Control	3473
Benlate	4181
Rovral	3639
Easout	4220



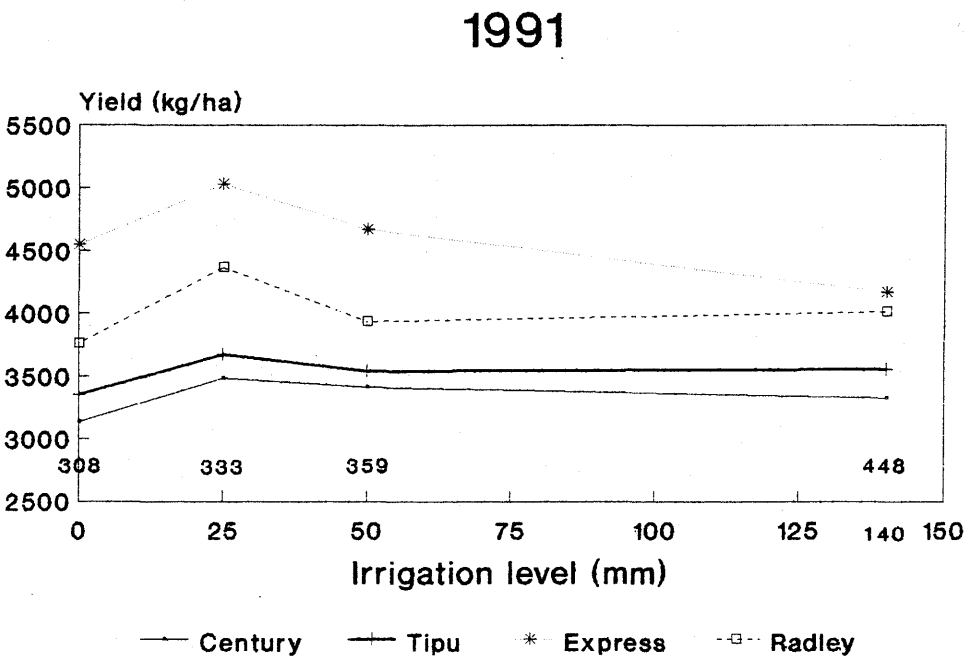


Fig. 1. Yield response of Century, Express, Radley, and Tipu pea to irrigation: 1990 and 1991. In season rainfall was 231 mm in 1990 and 308 mm in 1991.

SUMMARY

The specialty crops development program at the Saskatchewan Irrigation Development Centre, Outlook is designed to define optimum cultural practices for irrigated pulse crops, including field pea. Cultivars suitable for irrigated production were identified through various cooperative tests. Short stature registered cultivars susceptible to yield reduction due to drought under dryland conditions were generally very suitable for irrigated production. Early seeding generally increased yield and seed quality depending on the year and cultivar. For irrigated production, the seeding rate could be reduced from 80 to 55 seeds/m^2 without affecting yield. Higher seeding rates resulted in reduced plant stands with no yield advantage. Stand density and yield were unaffected at seeding depths of 2.5, 5.0, and 7.5 cm under irrigated conditions. Intermediate levels of irrigation (25-75 mm) increased yield. High irrigation levels (125-250 mm) tended to reduce seed yields, due to increased disease (*Sclerotinia*) incidence. Yield losses associated with high irrigation levels and with environmental conditions conducive to disease development could be reduced by foliar application of fungicides in some years. Short, semi-leafless, erect pea cultivars are preferred for irrigated production to avoid crop losses due to lodging and disease incidence.