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Pea-Cereal Intercrops for Forage Production has advantages

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Benefits of a pea-cereal intercrop for forage production included nitrogen (N) fixation and transfer of fixed N from the pea to the cereal component while maintaining dry matter yields equivalent to a cereal monocrop.

Intercropping pea with a cereal crop for forage production is gaining interest as a way to reduce nitrogen fertilizer costs, suppress weeds, and optimize the crop resources used, such as water and nutrients. However, current agronomic recommendations for cereal crop species, cultivar selection, and optimal seeding ratio are not well established. In addition, it is unknown if applying a starter N fertilizer to the intercrop will reduce the amount of biological N fixation by the pea and subsequently minimize the fertilizer cost savings of the intercrop.

A study was conducted to (1) compare the performance of forage barley, oat, and pea monocrops to pea-barley and pea-oat intercrops with and without the addition of N fertilizer; (2) measure the N fixation and N transfer of pea to the barley or oat in the pea-cereal intercrops; and (3) determine the effect of starter N fertilizer on N fixation by the pea intercrop component.

The 2-year study was established at the Agriculture and Agri-Food Canada research stations at Saskatoon, Melfort, and Swift Current in 2016 and 2017. CDC Maverick was used as the forage barley cultivar and CDC Haymaker was used as the forage oat cultivar. The forage pea cultivars used were CDC Horizon, a semi-leafless variety selected for improved standability, and 40-10, a conventional leaf-type variety.

Monocrop seeding rates were 110 lbs/ac for CDC Horizon pea, 104 lbs/ac for 40-10 pea, 142 lbs/ac for barley, and 106 lbs/ac for oat. Intercrop seeding rate ratios were 100:30 and 50:50 pea:cereal, with the ratio calculated as a percentage of the monocrop seeding rate.

Nitrogen fertilizer rates tested to determine the yield response of the forage blends were 0 lbs N/ac and 54 lbs N/ac. In order to measure the effect of N fertilizer on pea N fixation and crop yield, sites with low soil N (22 - 31 lbs N/ac at 0 - 6" depth) were selected and N fertilizer was added to reach 54 lbs/ac of soil N + fertilizer N for the fertilizer treatment plots.

All three research sites received above average growing season precipitation in 2016, and below average rainfall and warmer conditions in 2017.

Pea-cereal intercrops yielded similar to cereal monocrops

The pea-cereal intercrops yielded significantly higher than both of the pea monocrops at all three sites. Forage dry matter in the intercrops increased by 52 - 73% in Melfort, 68 - 118% in Saskatoon, and 25 - 69% in Swift Current compared to the pea monocrops. Compared to the cereal monocrops, the pea-cereal intercrops showed no significant difference in dry matter yield.

Nearly all of the intercrop seeding ratio combinations yielded the same, except for the 40-10 pea-oat at 100:30 at Saskatoon and Swift Current, and 40-10 pea-barley at 100:30 at Swift Current, which all yielded significantly less. Within the intercrops, the cereal species was the dominant component, contributing to 65 - 92% of the dry matter yield, regardless of the seeding ratio. The pea component in the intercrop accounted for 11% of the yield at the 50:50 pea:cereal seeding ratio and 26% at the 100:30 ratio.

The addition of N fertilizer (54 lbs N/ac) increased the forage dry matter yield of the intercrops at the Melfort site only; no yield difference was found at Saskatoon or Swift Current. The Melfort site was also the only site that showed significantly higher lodging of both intercrops and monocrops. The 40-10 pea monocrop displayed the most lodging at all sites, and standability of 40-10 improved significantly when intercropped with a cereal.

Pea provided N for cereal component in the intercrop

Nitrogen fixation in the intercrops was 13 - 26% higher than in the pea monocrops; the authors contributed this finding to the cereal plants continuously using soil N, thus promoting a faster rate of N fixation by the pea plants. However, when total N fixation was compared over a unit area, pea monocrops fixed more N than the intercrops because there was a higher density of pea plants in the monocrops. Within the intercrops, the 40-10 pea cultivar fixed more N than CDC Horizon. The pea component of the intercrops transferred 17 to 43% of the fixed N to the cereal component of the intercrop.

Using a starter N application of 54 lbs/ac significantly decreased N fixation at 2 out of the 3 sites - N fixation was 22 to 63% lower at Melfort and 35 to 65% lower at Swift Current. However, when the total amount of fixed N was compared on a per acre basis, there was no difference if starter N was used or not. This was because the total amount of fixed N correlated to the proportion of the pea component of the intercrop, and pea plant density and vigour were both higher under the starter N treatments. The authors concluded that when soil N is low (<22 lbs N/ac at 0-6" depth), using starter N in a pea-cereal intercrop would help increase dry matter yield under moist growing areas (Black soil zone) without negatively affecting the total N fixation per unit area.

Pea-cereal intercrops provided as much forage yield as cereal monocrops, while supplying a significant amount of fixed N from the pea to the cereal component. The intercrops showed a faster rate of N fixation than the pea monocrops, though total N fixation was higher under pea monocrops because of the higher pea plant population per area. Starter N fertilizer reduced the amount of N fixation in intercrops at two sites, but because total N fixed per unit area did not change, starter N could provide a yield benefit under moist soil zones.

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