HIGH-YIELD, HIGH-PROTEIN CWRS WHEAT CULTIVARS
I. Yield, Yield Components, and Phenology

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Introduction

Some recently developed CWRS cultivars have significantly increased yields, while maintaining or even increasing protein content, relative to earlier cultivars. Such cultivars, which meet the demands of the lucrative quality-conscious world markets, have made a substantial contribution to the value of wheat production in western Canada. The physiological basis for these genetic improvements, however, is unknown, especially considering the well-known negative relationship between yield and protein concentration.

The results described in this study are from the first year of a multi-year study, and should be interpreted with caution. However, the results are in close agreement with earlier studies concerning the yield and yield components of the new cultivars.

Objective

To determine the mean differences between a group of new CWRS cultivars (AC Barrie, AC Cadillac, AC Elsa and AC Intrepid) developed at SPARC and a group of two old cultivars (Neepawa and Marquis) in terms of yield, yield components, and phenology.

Materials and methods

Plant material and growing conditions: Four new (AC Barrie, AC Cadillac, AC Elsa and AC Intrepid) and two old (Marquis and Neepawa) CWRS cultivars were selected based on previous yield data. Plants were seeded in a randomized complete block design with four replicates on a Swinton loam soil on 28 April, 1998 at Swift Current. Plots were seeded on fallow with 16-row, 3 m long and 0.23 m apart. Winter wheat of 1 m wide was seeded between plots to standardize border effects. The plot area was fertilized with 12 kg N ha-l and 15 kg P205 ha-l before seeding.

Plant measurements: Leaf emergence rate and phasic development were observed every 2-3 days for each plot. Above ground plant samples were taken at terminal spikelet, flag leaf ligule visible (FLLV), anthesis complete and physiological maturity by cutting a randomly chosen 50-cm length of row from each plot for measurements of leaf area, dry matter and N concentration. All plots were harvested by a plot combine to determine yield, kernel weight, and protein content.

Results and discussion

Grain yield and protien

New cultivars yielded an average of 24% more than the old cultivars without sacrificing protein content. Of course most of this yield gain has been made relative to the much older Marquis not

Neepawa. The new cultivars yielded 39% more than Marquis but only 12% more than Neepawa. The mean protein content was 15.2%, with no significant differences among cultivars. Since the new cultivars yielded more than the old cultivars, with no differences in protein content, new cultivars also had higher protein-yields than old cultivars by approximately 26%.

Yield components:

Grain yield is simply the product of kernel weight times the kernel number per unit area.

Kernel weight and Kernel number per unit area: The **24%** mean yield increase observed for the new cultivars resulted equally from a 12% increase in kernel weight (Fig. 1) and a 12% (Fig. 2) increase in kernel number per unit area.

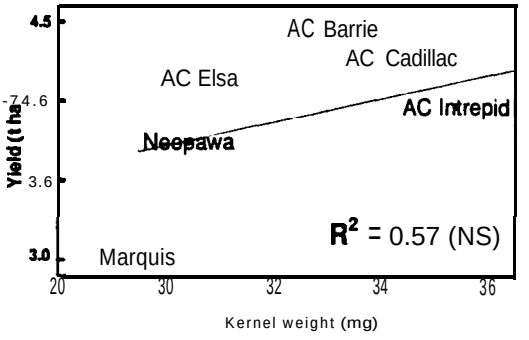

Fig. 1. Yield and kernel weight.

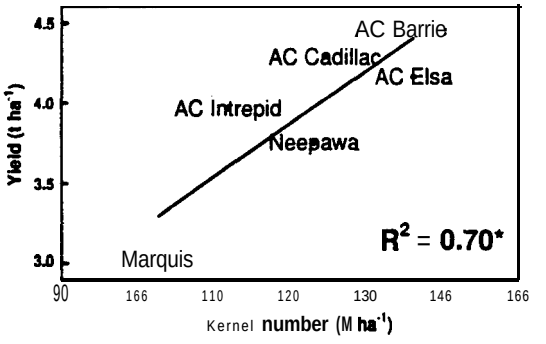

Fig. 2. Yield and kernel number.

To better determine the origin of the increases in kernel number, we examined the components of this variable: plants per unit area, spikes per plant, and kernels per spike.

Plants per unit area: The new cultivars averaged 4% fewer plants per unit area than the old cultivars, although this difference was not significant (P = 0.34).

Spikesperpfant: The new cultivars averaged 5% fewer spikes per plant than the old cultivars, but this difference was not significant (P = 0.35).

Kernels per spike: The new cultivars produced 2 1% more kernels per spike compared to the old cultivars, which was highly significant (P = **0.003).** It appears that the entire 12% yield increase of new cultivars due to the increase in kernel number per unit area, can be accounted for by the increase in the number of kernels per spike (Fig 3). The 21 % increase in kernels per spike translated into only a 12 % increase in kernels per unit area, probably because of the decreases in the number of plants per unit area and spikes per plant described above for the new cultivars, which were not statistically significant, but may have been real.

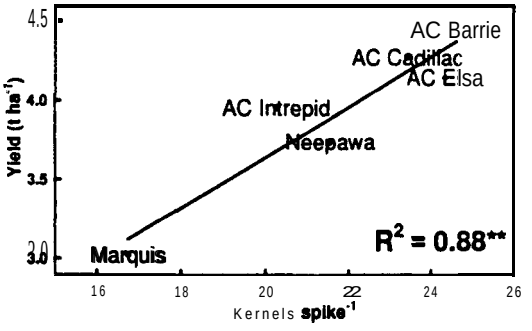

Fig 3. Yield and kernels per spike.

Phenolom

There were no differences in the duration of Phase I (emergence to terminal spikelet) for the old and new groups of cultivars, both being 25 days (Fig. 4). The durations of the remaining three growth phases were all significantly different between the old and new cultivars. Phase II (terminal spikelet to FLLV) was three days longer for the old cultivars, being 24 days for the old and 21 days for the new cultivars. Conversely, Phase III (FLLV to anthesis complete) was 2.3 days longer for the new cultivars. Both groups reached the grain filling stage (Phase IV) after 67 days, but the new cultivars spent more time in Phase III, which included anthesis, while the old cultivars spent more time in Phase II. The grain filling stage (Phase IV) was 2.4 days shorter for the new cultivars, so that they actually reached maturity three days sooner than the old cultivars. Since the new cuitivars yielded 24% more than the old cultivars, and they spent less time filling the grain, the rate of grain filling was **26%** greater for the new cultivars (Fig. 5).

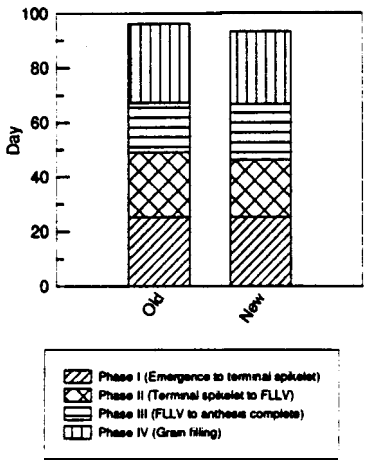

Fig 4. Growth Phases for old and new cultivars

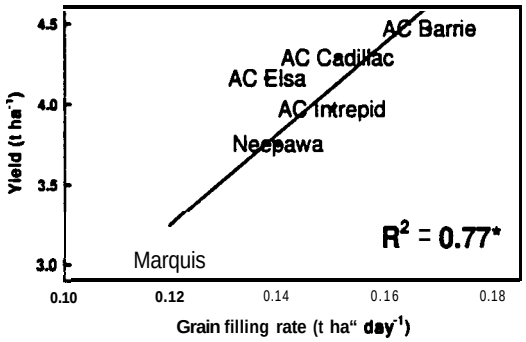

Fig 5. Yield and grain filling rate.

Conclusions

Four recently registered CWRS cultivars (AC Barrie, AC Cadillac, AC Elsa and AC Intrepid) yielded a mean of 24% more than the mean of two old cultivars (Neepawa and Marquis). The yield increase resulted from a 12% increase in kernel weight and a 12% increase in kernel number. The increase in kernel number was entirely due to an increase in the number of kernels per spike for the new cultivars. Since the duration of grain filling was actually less for the new cultivars, the increased yields resulted from an mean grain filling rate that was 26% greater than the rate for the old cultivars. Further research is needed to confirm these differences between new and old cultivars, and to examine differences among the new CWRS cultivars.